VOL. LXXXII PART ELEVEN

JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

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our gardening expert

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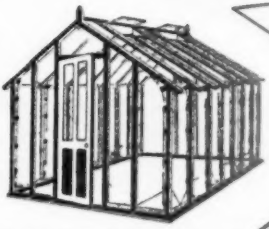

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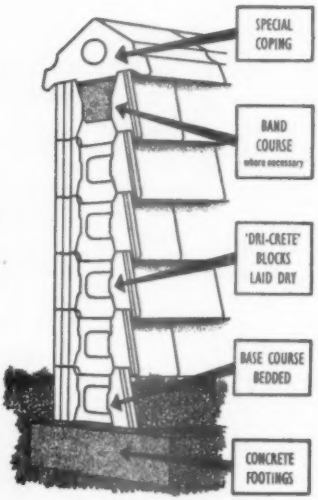

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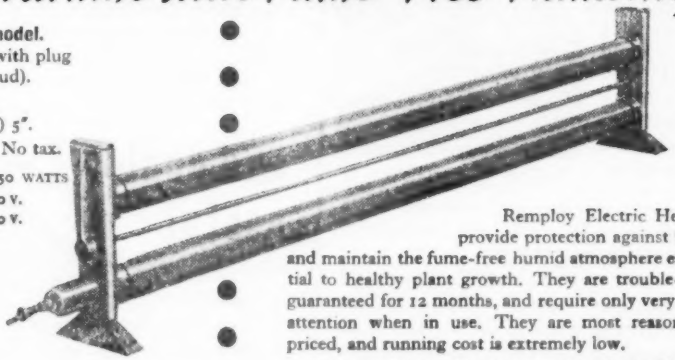

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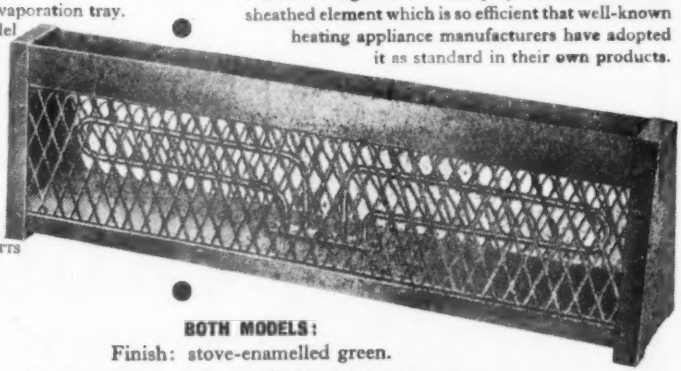

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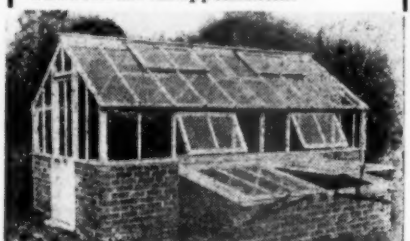

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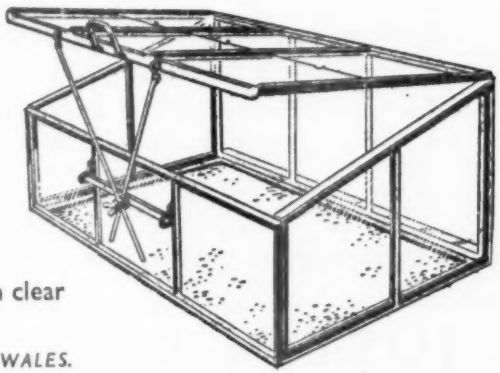

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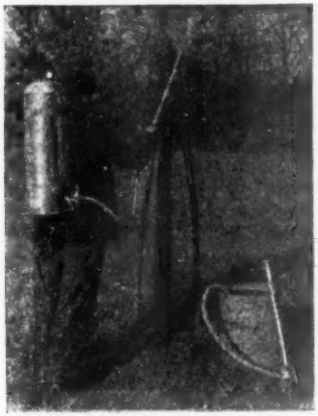

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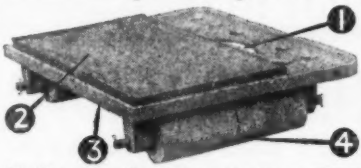

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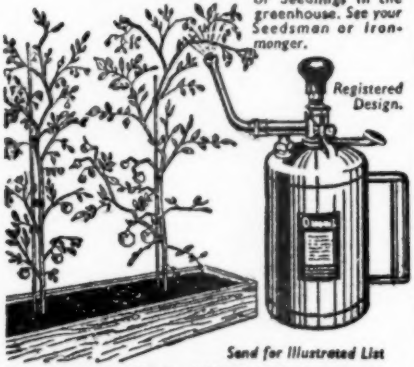

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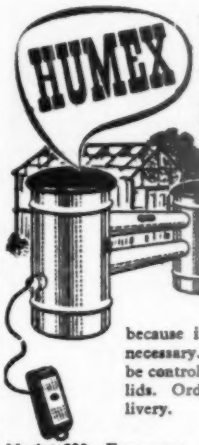

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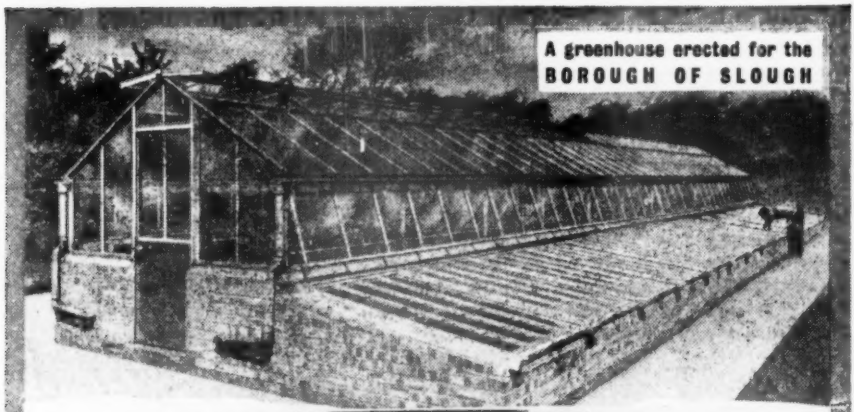

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JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

VOL. LXXXII PART ELEVEN

November 1957

THE SECRETARY'S PAGE

ANNOUNCEMENTS—NOVEMBER AND DECEMBER

Shows

TUESDAY, November 5 12 NOON to 6 P.M. WEDNESDAY, November 6 10 A.M. to 5 P.M.	Fortnightly Flower Show and British National Carnation Society's Competition, in the New Hall.
FRIDAY, November 8 1 P.M. to 7.30 P.M. SATURDAY, November 9 10 A.M. to 6 P.M.	National Chrysanthemum Society's Show, in the New Hall.
TUESDAY, November 19 12 NOON to 6 P.M. WEDNESDAY, November 20 10 A.M. to 5 P.M.	Fortnightly Flower Show, in the Old Hall.
TUESDAY, December 3 12 NOON to 6 P.M. WEDNESDAY, December 4 10 A.M. to 5 P.M.	Fortnightly Flower Show and Late Apple and Pear Competition, in the New Hall.

Lectures

TUESDAY, November 5, at 3 P.M. Masters Memorial Lecture. "The Water Requirements of Crop Plants in the United Kingdom", Part II, by MR. E. J. WINTER, M.C., M.SC.

TUESDAY, December 3, at 3 P.M. "Plants on a Journey: Aspects of Plant Collecting on a Journey by Car—London–Katmandu–London", by MRS. J. BROUGH.

Demonstration at Wisley—There will be a demonstration at Wisley on Wednesday, November 20, on "The Pruning of Fruit Trees". The demonstration will commence at 11 A.M., and will be repeated at the same time on Thursday, November 21.

The Society's Examinations in 1958—Candidates wishing to enter for the Society's Examinations in Horticulture to be held in 1958 are reminded that the closing dates for the receipt of entry forms are as follows: General Examination in Horticulture, and General Examination in Horticulture for Juniors—Monday, January 13, 1958; National Diploma in Horticulture, Intermediate and Final Examinations, and N.D.H. Honours—Saturday, February 1, 1958; Teacher's Diploma in School Gardening, Intermediate and Final Examinations—Saturday, February 1, 1958.

Wisley Gardens: Reduced Admission by Ticket—At the last Annual General Meeting the President referred to the very large number of visitors to the Wisley Gardens and said that if there were so many visitors that the Gardens became uncomfortably crowded their value to Fellows would be reduced. He explained that it was thought that the petrol rationing which was then in force would probably ease the situation, but in the near future it might be necessary to reduce the number of persons who could obtain admission on presentation of one ticket. Happily, petrol rationing has ceased, but unhappily, as was anticipated, the Gardens have become uncomfortably crowded at certain times, especially at weekends. Consequently, in the interest of Fellows, who provide the Gardens, and for whose use they are primarily intended, the Council has decided that from January 1, 1958, each ticket shall admit only two persons.

NOTES FROM WISLEY

LAST month we noticed some of the more striking plants to be seen in the stove house, where at any season of the year there is much to interest the visitor. The same may be said of the temperate house, and as there are many plants growing in this large house which have never achieved notice in these monthly articles, we may devote this article to some of them.

The large centre bed contains many plants which in a state of nature would rapidly grow into trees, and it is unfortunate that as soon as they begin to show their full beauty many reach the glass and have to undergo severe pruning. Nevertheless, most are of interest before they reach a large size.

On entering the south door one sees at once a tall specimen of *Tibouchina semidecandra*, first brought to European gardens from Brazil in 1862. The vivid violet colour of the broad, saucer-shaped flowers is

arresting. Closer examination reveals the odd arrangement of jointed stamens characteristic of the family *Melastomaceae* to which the plant belongs. The dark, velvety leaf, with five strong veins running its length, is also distinctive. Beside it grows another Brazilian, the tree tomato, *Cyphomandra betacea*, a stout, erect shrub with very large leaves and racemes of fragrant pinkish flowers succeeded by large, dark purple, egg-shaped fruits. These are edible and have a tomato flavour, but some may find unappetizing the red juiciness of the inside, which is somewhat suggestive of raw meat. A third native of Brazil with a more acceptable fruit can be seen a few feet away. This is the strawberry guava, *Psidium cattleianum*, a compact evergreen bearing globose, claret-coloured berries, the size of a small plum, filled with juicy, strawberry-flavoured flesh.

Starting to walk along the east side of the house one passes beneath a canopy formed by the trained branches of an old fuchsia of the variety 'Rose of Castile', which responds to this treatment better than to pot-culture. For many months it produces freely its large blooms, which have pinkish tube and sepals and violet petals. From the roof a few yards away hang the long trails of *Lonicera hildebrandiana*, the giant honeysuckle of Burma, Siam and China, which is too tender to be grown in the open here, and too vigorous for a moderately-sized house. In late summer it produces rather sparingly sprays of paired flowers, each 6 inches long, opening creamy-white and passing to straw yellow as they age. Beneath it grows another plant with outsize flowers, namely, *Rhododendron* 'Tyermanii', a hybrid raised from a cross between *R. formosum* and *R. nuttallii*, two species of the Maddenii series. For many weeks in the spring the rather straggling growths of this lovely variety are decked with huge, open, funnel-shaped white flowers, in trusses of three. Not many rhododendrons take kindly to the rather crowded conditions here, but a dense bush of *R. mucronatum* provides very welcome flowers over quite a long period in winter, and the fragrant pink blooms of *R. ciliicalyx* also come when flowers are scarce.

Many things demonstrate clearly their preference for being planted in the bed, rather than in pots. *Asclepias curassavica* attains a height of 5 feet, with strong, leafy stems bearing in long succession clusters of red and orange flowers and flask-shaped fruits. *Jacobinia carnea* greatly exceeds this stature, producing massive spikes of bright pink flowers. The shrimp plant, *Beloperone guttata*, with an unrestricted root-run, makes a bush 4 feet tall and 3 feet across, densely leafy and covered all the year round with cinnamon-bracted inflorescences at every branch-tip. The species of *Luculia* likewise respond well to being planted out. The most recent addition to this group, already noted for its fragrant blooms, is *L. grandifolia*, which was collected in Bhutan by LUDLOW and SHERRIFF. Its strong, erect stems carry pairs of elliptic-ovate leaves nearly 12 inches long and huge terminal corymbs of pure white flowers, each with a narrow tube $2\frac{1}{4}$ inches long and a flat limb $1\frac{1}{4}$ inches across.

Some of the occupants of the centre bed valuable for their long-

flowering period are *Cestrum aurantiacum*, orange-flowered, the rose-coloured *C. purpureum* var. *smithii*, and *Cassia corymbosa*, which has handsome glossy pinnate foliage and attractive yellow flowers well displayed on long axillary peduncles. All of these grow fast, but happily they tolerate severe trimming. The Hawaiian *Hibiscus waimeae*, which would soon make a small tree, has to be restricted, but despite harsh pruning rarely fails to please with a show of large white, pink-stamened autumnal flowers.

A large specimen of the evergreen *Elaeocarpus cyaneus*, useful alike for its abundant white, fringed blossoms and blue berries, has at last been removed from a place in the west side of the main bed, where it has for a long time heavily shaded a number of other plants. Several camellias are reaching the roof glass, and as the genus is extremely well represented elsewhere in the Gardens they may soon be considered redundant. The variety 'White Swan' dominating the south end, is always greatly admired in mid-winter, as is 'Magnoliaeflora', represented here by an enormous bush of a well-coloured form, and the specimen of 'Adolphe Audusson' has become very large and dense. A variety which well deserves the space it occupies is one which came to Wisley under the name *C. sasanqua* var. *fragrans*. There is, however, no reason to doubt that it is the variety 'Narumi-gata', which received the Award of Merit several years ago when exhibited from Bodnant. From September onwards it opens large saucer-shaped flowers of white, flushed with apple-blossom pink and centred with golden stamens. Its faint odour seems scarcely to justify the use of the epithet "fragrans".

Hanging from the roof-ties at the north end of the house there is an old globular specimen, several feet across, of the elk's-horn fern, *Platycerium bifurcatum*, an Australian epiphyte of remarkable habit. It has two kinds of fronds: one is flat and plate-like, pressed against the support on which the plant grows, soon becoming dry and parchment-like. Roots from the stem thread their way between successive layers of these sterile leaves, where dust and debris soon collect. The fertile fronds are 2 or 3 feet long, pale grey-green and forked into narrow segments. Not long ago the weight of this great plant snapped the supporting wires, and it fell into a water-tank, whence with some trouble it was recovered, rather bruised but doubtless refreshed by the immersion.

Among the plants of character on the west side of the main bed *Cestrum parqui* is probably scarcely noticed by most visitors. Its great panicles of greenish-yellow blossoms are easily overlooked in the daytime, but at night their strong scent fills the house. It has a rival in *Michelia fuscata*, an evergreen shrub related to the magnolias, whose rich fruity odour is perceived before its rather small, brownish flowers are noticed. The large and varied genus *Clerodendron* is represented by *C. ugandense*, a plant of tall and rather straggling growth, with wand-like stems bearing large open panicles of pale blue flowers for many months of the year.

The side benches in this house are filled with flowering pot-plants

such as begonias, pelargoniums, achimenes and others which provide a display throughout the season. Overhead the roof-supports are covered by a variety of ornamental climbers. On the east side, in addition to those already noticed, there are *Hoya carnosa*, the Wax Flower; *Solanum wendlandii*, which in May and June has immense panicles of mauve potato-like flowers; *Lonicera splendens*, a glaucous-leaved honeysuckle with cream flowers and orange berries; *Jasminum angulare*, a dark-leaved evergreen with a long succession of large fragrant white blooms; *Lapageria rosea* with sheaves of waxen flowers hanging from wiry stems; and *Pandorea jasminoides*, a less common climber with pinnate leaves and bunches of large white, crimson-throated flowers.

The most rare of the climbers on the west side is the antipodean *Tecomanthe speciosa*, a very vigorous bignonia-like plant with massive dark leaves. The flower, which has not been seen yet at Wisley, is light apricot in colour, and resembles that of *Campsis radicans* in shape, and possesses certain structural peculiarities of more interest to the taxonomist than to the gardener. Several kinds of passion-flower are to be seen here, and one of the most ornamental is the hybrid 'John Innes', which originated at Bayfordbury recently from a cross between the two species *Passiflora quadrangularis* and *P. racemosa*. It has a large, nodding, cup-shaped flower with pale claret-coloured petals, and a corona composed of long filaments barred with white on a maroon and violet ground colour.

Some other useful climbers are *Hibbertia dentata*, with golden flowers like those of a hypericum; *Jasminum polyanthum*, unrivalled in late winter for its sweet scent and abundant bloom; and *Macleania insignis*, which flowers nearly all the year round. It has long, unbranched growths with leathery leaves red in the young state and long terminal racemes of narrowly tubular, flame-tinted flowers.

The collection of succulent plants, which interests a great many visitors, has lately been enlarged and contains representatives of a large number of different genera. Of the euphorbias there are *E. grandicornis* with heavily armed, winged stems, *E. grandidens* with equally thorny forked growths, and *E. splendens* with gay vermilion flowers. *Bryophyllum daigremontianum*, with angular leaves fringed with tiny plantlets, and *B. tubiflorum*, in which this reproductive activity is confined to the leaf-apex, are always popular. In addition, there are examples of *Stapelia*, *Crassula*, *Aloe*, *Phyllocactus* and others whose appeal lies largely in their unusual vegetative character.

MIST TECHNIQUE PROPAGATION

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(*Lecture given on July* 30, 1957, PROF. R. H. STOUGHTON, D.SC., V.M.H., *in the Chair*)

MR. F. P. KNIGHT: Plant propagators have always been aware of the vital importance of keeping soft leafy cuttings turgid, and supplying these with water when required and showing restraint in withholding it in dull weather. Horticulturists have not lagged behind during the post-war years in taking advantage of modern engineering developments and adapting these to make progress in the propagation of plants. A combination of the skilled engineer and propagator has resulted in the design and manufacture of specialized equipment which keeps cuttings wet with an intermittent mist whenever this is required. MR. BEAN of the National Institute of Agricultural Engineering will describe some of the engineering work which has been done, and it is my function to draw attention briefly and in non-scientific language to installations of suitable equipment in various establishments other than at Wisley, and MR. HANGER will give an account of the work there.

In 1912 PROFESSOR BAYLEY BALFOUR in his Masters Memorial Lecture on "Problems of Propagation" to this Society described the use of the "sun frame" for raising plants. This, as I knew it at the Royal Botanic Garden, Edinburgh, consisted of a frame with double glass lights, that is, one frame inside another with an air space between. The frame was fully exposed to sunlight and young cuttings of various plants were inserted in coarse sand in the frame in the height of summer and watered by hand with tepid water at frequent intervals when the sun was shining. The work involved in the frequent lifting of the lights was troublesome and obviously it would have been a boon if the supply of moisture could have been given whenever required by the use of specialized equipment.

In the early 1930's a good deal of investigation was done by E. E. PYKE at the Imperial College of Tropical Agriculture, Trinidad, on the rooting of cacao cuttings. This work was continued at intervals until DR. H. EVANS reviewed it quite extensively and investigated the method of rooting cacao cuttings under actual mist. While investigating the influence of light intensity he found the cuttings were most successful under a continuous mist provided they were shaded from 75 per cent of the sunlight. In full sunlight heavy chlorophyll leaching took place.

Much of his work concerned the method of taking the cuttings, the amount of shading required, the type of compost to use, etc. The use of intermittent overhead watering seems to have been incidental to the work although he was well aware of what he wanted to do—namely to root his cuttings in full sunlight, thus benefiting from full photosynthesis. To do this the cuttings must be cooled and intermittent mist proved the most successful means.

It was not until 1941 that a real step forward was made when in the U.S.A. an account by M. A. RAINES entitled "Some uses of a spray chamber in experimentation with plants" appeared in the *American Journal of Botany*, "Propagation under Mist", by EDWARD J. GARDNER, in the *American Nurseryman* and "Difficult cuttings respond to use of overhead mist spray", by G. M. FISHER, in *Florist Review*.

Rapid progress, however, did not come until between 1950–56 when various research stations and commercial establishments, first in the U.S.A. and then in Holland and to a limited extent in this country, demonstrated developments both in the design of equipment and the selection of suitable cuttings and rooting media, and the after care of the new young plants.

It is too early to give detailed accounts of the way in which a wide range of plants has responded in this country but I hope it will be possible in future years to follow up this preliminary account with progress reports.

The provision of mist ensures that the leaf surface of a cutting is continuously covered with a film of moisture regardless of weather conditions. Much ingenuity has always been required on the part of propagators when taking soft cuttings—particularly from outdoor plants in the summer—to keep these from wilting before they are inserted in propagating frames. The wet sack which was often used as a container can now give way to polythene wrapping, showing another instance of adapting modern materials for gardening purposes. Cuttings should reach the propagating beds in a fresh condition, although it has been noticed that the application of mist will soon revive many which show slight wilting.

Mist technique propagation in the U.S.A. is described in considerable detail in the *Proceedings of the Plant Propagators Society* of that country and I am indebted to MR. JAMES S. WELLS, who was their first president, for lending me several of the slides with which to illustrate this account. Further accounts of American work may be found in the *Report of the 14th International Horticultural Congress 1955*, Vol. II. The commercial production in the U.S.A. of large quantities of woody plants such as magnolias, evergreen azaleas, *Acer palmatum* varieties and hardy hybrid rhododendrons is now dependent on the mist technique and very extensive and efficient installations are in operation.

In Holland many who attended the 14th International Horticultural Conference were privileged to see the work being carried out at the Institute for Horticultural Plant Breeding at Wageningen by DR. FLOOR

and his staff, and were particularly impressed with the rooted cuttings of *Acer saccharinum*, *Betula* and *Tilia*. The mist technique was also demonstrated to us at the School of Horticulture, Boskoop.

In this country mist technique equipment is in use in several establishments, both at experimental and research stations and in nurseries.

At East Malling Research Station considerable work has been carried out on cuttings of fruit tree root stocks in protected beds out of doors. Some of this work is described in the *Annual Report of the East Malling Research Station for 1956* (1957) and a further account is due to appear in October 1957 in the *Journal of Horticultural Science*. DR. W. S. ROGERS kindly showed the East Malling installation to MR. HANGER and myself on July 12, 1957.

Plant Protection Research Station at Fernhurst has been using the mist technique since the autumn of 1955 mainly for propagating carnations and chrysanthemums on a large scale and I am indebted to The Director for the use of illustrations showing the work there.

The Directors of the N.A.A.S. Experimental Stations at Rosewarne in Cornwall and Stockbridge House, Yorkshire, are experimenting with mist and both have lent illustrations for this account. MR. F. W. SHEPHERD of Rosewarne has written to say that where he had installed mist equipment on an open bench in a greenhouse which was also being used for other purposes he found that draughts from the ventilators caused an uneven distribution of the mist and he therefore had to enclose the bench. He points out that among other plants, he is working with *Pittosporum tenuifolium*, which is an important commercial plant for cut foliage and has found that cuttings of this which have reached him in a wilted condition have recovered and rooted under the mist, but he goes on to say "we do prefer to keep the cuttings turgid all the time".

MR. F. G. SMITH of Stockbridge House has been working on chrysanthemums and states that although so far he has not carried out critical experiments he finds with very soft chrysanthemum cuttings he gets best results from using peat and sand in equal proportions by volume.

Nurserymen are showing considerable interest in mist technique propagation and following a period of finding out the snags some have now installed up-to-date equipment. The largest I have seen is that at Messrs. G. R. Jackman's Nursery at Woking. A different type of equipment was shown at this year's Chelsea Flower Show by Messrs. MacPenny and I saw the propagating bed they had equipped with this at their nursery at Bransgore, Hants, on May 24, 1957.

MR. GRAHAM BEAN: Scientific workers and advanced growers for a long time have used the principle of overhead water-cooling while taking advantage of placing their cuttings in full sunlight and, as so often happens, the engineer had revolutionized an ages-old process and, on behalf of the horticulturist, has brought automation into the propagating house.[1]

HESS AND SNYDER

Many names connected with the development of this technique could be mentioned but the two which spring to mind most easily are HESS[2] and SNYDER[3] of Cornell University, because it was they who chose to read papers on the subject at the 14th International Horticultural Congress held in Holland in 1955.

Snyder drew attention to the difference between humidification and the mist technique. This is very important and is worth repeating. Humidification implies filling the air surrounding the cuttings with very fine particles of water in order to raise the relative humidity. It is incidental that the leaves are wetted. The high relative humidity reduces the rate of transpiration.

On the other hand the mist technique deliberately sets out to wet the leaves, thus cooling them, reducing the vapour pressure within and thereby reducing transpiration.

VARIOUS METHODS

The mist can be continuous or intermittent. The continuous mist has several disadvantages besides its liability to cause leaching. It uses more water than the intermittent method; it saturates the growing medium and thus cools it, which is most undesirable; the leaching can be so serious that the cuttings die before they have had a chance to produce roots to enable them to escape from the propagating bench. And being continuous the cooling effect is operative even when it is unnecessary.

But, of course, an intermittent mist is not quite so simple to arrange and, as one would expect, it has been accomplished in a number of different ways.

HAND CONTROL

Clearly, the first to mention is the hand control method which can be as simple as a hose or watering can, or an array of spray nozzles controlled by a hand-operated tap and sprinkling over the bench. Any of these can be operated by a member of the staff responsible for the cuttings. The method is flexible, perhaps too flexible, and could even be unreliable. It is cheap enough to install but tends to be expensive when it comes to week-end operations and is unlikely to be popular when watering is required at intervals through the night as might well occur in the early spring and late autumn when there is a good deal of heat on the house at night.

TIME CLOCK

The use of a time clock is the simplest automatic method since all that is required is a constant speed mechanism which is able at intervals, to turn on the water spray for a period. Some time clocks are so arranged that the intervals between bursts of water and also the length of the bursts are both adjustable independently. For instance, the bursts might be made at 20-minute intervals and of 3-seconds duration; or any other combination within a certain range can be obtained by simple adjustment

In dealing with the type of weather usually described in this country as "with sunny intervals" the system is less flexible than the hand method. But where clear skies predominate for long periods, as we are led to believe occurs in, for instance, the Western States of America, the rigid time-clock system is quite suitable and is favoured.

SENSITIVE BALANCE

Another method of obtaining control, this time with automatic adjustment is by a sensitive weighing machine. This is balanced by the weight of water collected from the mist spray. When the water is evaporated by the sun the weighing machine is unbalanced and, by an electrical circuit, operates a solenoid valve which controls the mist. When the balance pan has caught enough water it stops the mist.

PHOTO-ELECTRIC CELL

A photo-electric cell is a device which is able to measure the incoming energy of the sun. By experiment the amount of energy required to evaporate a certain quantity of water can be found. The apparatus can be made to add up the incoming energy and when the required quantity has been counted a solenoid valve can be operated for long enough to replace the amount of water calculated to have been evaporated.

Unfortunately the photo-electric cell does not operate at night so that it does not protect the cuttings during this period when, at some parts of the year, more water may be lost than during the day.

"ARTIFICIAL LEAF"

The American preference for a simple method such as the clockwork mechanism is sometimes used as a criticism of our more complicated approach. But I feel we are sometimes criticized just because we are different to the Americans. I am happy to give praise where it is due and there are many occasions when the Americans can do and have done things better than we in this country. In this particular case, where flexibility is required, I am quite sure that our self-adjusting artificial leaf is better than anything they have devised so far (Fig. 136). Not *only* that, but it will have so many other uses in the future. Some of these are already the subjects of patents originating from Wrest Park.

The device is sometimes called an electronic leaf. As it happens it bears very little relation to a leaf and it is in no way electronic. It is merely an instrument, whereby the presence of moisture can be detected by a controlling electrical circuit.

There are several forms of this device obtainable. The one devised by the National Institute of Agricultural Engineering is now produced by Burgess & Co. (Engineers) Ltd., Easthampstead Road, Bracknell, Berkshire.

Other scientific workers and other manufacturers have reached a similar result by other means and the commercial units are mentioned elsewhere.[4]

THE N.I.A.E. LEAF

The leaf is placed amongst the natural leaves of the cuttings so that it receives sun and mist in similar proportions. Unlike some other forms of artificial leaf the N.I.A.E. model is affected by heat in a similar manner to the natural ones so that it is on duty at night as well as during the day.

The design of the leaf is the subject of a patent.[5] The cable and insulation are polythene plastic and can therefore be welded. This ensures a water-tight covering for the join of the precious metal electrode tips. In this case they are platinum to avoid corrosion.

Polythene cannot be wetted so a slip of filter paper lies between the electrodes. This paper is absorbent and the water loss over the surface is constant. When it becomes impregnated with salts due to continual evaporation it can be very easily replaced. We advise that this simple duty should be done once a week.

THE CONTROLLER

A small leak of current is able to pass between the electrodes when the filter paper is wet. As this paper dries, resistance to flow increases. The controller measures this resistance and can be made to operate another electrical device at any predetermined degree of resistance. For the rooting of cuttings the special circuit [6] operates an electric water valve which supplies the mist. There are many other applications of this device.[7]

The controller opens the solenoid valve to give very short bursts—preferably $\frac{1}{2}$-second ones. If the leaf has not been wetted enough to reduce resistance to current flow another burst will be given in about 2-seconds' time. And more after this, if necessary. The 2-seconds delay allows all the mist to settle before the next burst and ensures the minimum use of water so that the control of the moisture is of extremely narrow range.

The whole electrical apparatus is fed through a condenser and therefore it is safe for handling within the glasshouse.

The system is self-starting since it is, in effect, measuring dryness.

THE WATER VALVE

The type of solenoid valve selected by the N.I.A.E. is a standard product of a reputable manufacturer. There are two sizes, one suitable for very small to medium installations and one which can handle up to 1800 sq. feet of bench.

THE NOZZLE LINES

The type of ceramic gas-jet nozzle used by the N.I.A.E. was selected and positioned to give good coverage over the propagation bench. It is important that the calibration of such nozzles is done in exact running conditions, i.e. that the mist is intermittent. Under continuous running air becomes entrained and a completely false picture can be presented.

It is absolutely imperative that any intermittent water system is arranged to prevent airlocks if a crisp burst is to be obtained. Air inside

the pipes is compressible and will give a poor quality mist. To prevent drainage all nozzles should be at the same level.

Only in rare cases is it safe to install a nozzle system without the protection of a fine mesh filter. The mesh must be finer than the nozzle orifice and must, of course, be cleaned as often as proves necessary—another obvious piece of advice but one which is so often ignored.

The more and the smaller the water drops the better is the coverage and the cooling effect. The proper quality of water drop is obtained by using the water pressure for which the nozzles were designed. Therefore before purchasing misting apparatus it is essential to know what water pressure will be available and incidentally, what source of electricity there is. The manufacturers are able to overcome the low water pressure in most instances and even lack of electricity supply but it calls for extra and specialized equipment.

FUTURE APPLICATIONS

Turning for a moment from the apparatus to consider how well it does the job for which it is used we find that the horticulturist judges it on two scores. One, that under the protection of the intermittent mist there are *amazingly few* subjects which do not root at all and, two, that in *almost all* cases of those that root they do it better and quicker than under any other method.

It is interesting to realize why this is so and to help in this it is possible to produce information which has been collected by completely unbiased machines.

At Wrest Park there are very accurate weighing machines holding about two tons of soil but accurate to changes of weight in the region of three or four matchsticks. In this soil we grow plants and can measure the quantity of water which they transpire during any period of time, be it as short as 10 minutes.[8]

This rate of transpiration is governed by the incoming energy of the sun—this too can be measured in heat units by a solarimeter.

By a simple calculation it is possible to discover how much water this amount of heat would evaporate and it is found that there is a relationship between the amount of sun the plants in the weighing machine receive and the amount of water they use.

This can be taken one stage further when we discuss the artificial leaf. It, too, is measuring evaporation. And if the weighing machine, the solarimeter and the artificial leaf are compared their respective answers are in close agreement.

At Wrest Park we have already experimentally controlled glasshouse irrigation automatically for three months without any human supervision. This is only a beginning.

MR. F. E. W. HANGER: MR. KNIGHT has spoken of the work that some of the various scientific and plant nursery establishments in U.S.A., Holland and also those in this country have carried out with mist propagation.

MR. BEAN has explained to you the secrets of the electronic leaf or hydrostat, as some people prefer to call it, also the mysteries of the solenoid valve, and the intricacies of the control box. Now it is my turn to tell you of our experiences at Wisley with "Intermittent Mist Technique Propagation".

First, I wish to emphasize the fact that the work carried out at The Royal Horticultural Society's Gardens, really amounts only to preliminary investigations touching just the fringe of possibilities when compared with that already accomplished in some research stations both in this country and abroad. "Intermittent Mist Technique Propagation" is in its infancy in this country, and it is hoped that this knowledge of Wisley successes and also its failures will in turn be helpful to those growers embarking on this new aid to plant propagation.

The turgescence of plant cuttings for the period immediately following their removal from the parent plant, until the cutting has developed its own roots is of the utmost importance. This is especially so in the case of plants which are normally difficult to root, when the leaves are still attached to the cuttings, and which may take up to several months to root. During this time high humidity in the atmosphere produced by mist spray will reduce the rate of water transpiration from the leaf, keeping the cuttings inflated with moisture and thus preventing wilting before rooting takes place.

"Mist Technique Propagation" governed with an electronically controlled apparatus which disperses fine almost atomized droplets of water in such a manner as to form a continual film of moisture round and about the entire cutting has been proved to give first-class results. By this means the leaf surface is kept constantly covered with a fine film of water, preventing loss of moisture from the leaf tissue.

At the 14th International Horticultural Congress, held during September 1955 at Scheveningen in Holland, various papers were read on this means of propagation, by WILLIAM E. SNYDER and CHARLES E. HESS of Cornell University, U.S.A., and also by DR. H. FLOOR of the Institute of Horticultural Plant Breeding at Wageningen, Holland. All agreed that moisture is the predominant factor in the rooting of cuttings with leaves attached, and again all stressed the importance of obtaining the correct type of nozzle, and all preferred the intermittent mist, electronically controlled, as opposed to constant mist. Various methods for controlling the intermittent mist were suggested, but the "electronic leaf" or hydrostat has proved to be the most advantageous, as the same factors which affect transpiration of the plant leaves, also affect the "electronic leaf". It was determined that intermittent mist is preferable to constant mist, and that rooting response was much greater under the former technique. A physiological study by SNYDER of cuttings has proved that the temperature of the cutting tissue in the medium under intermittent mist was 10–20° F. warmer than tissue under constant mist, and that the lower temperature in the rooting medium checked the rate of root formation.

Early in June 1956 with the co-operation of the National Institute of Agricultural Engineering, from Wrest Park, Bedfordshire, two installations of intermittent mist were erected at Wisley. One was placed inside the heated propagating house, and the second unit outside in the frame yard on a base of coal ashes.

The Propagation House at Wisley runs north to south with a door at the southern end, and *No. 1 Unit* is installed in the extreme 14 feet of the northern end, width being 9 feet 3 inches and the height to the ridge, 8 feet. This portion of the house was separated from the rest of the house by erecting a partition with a door 6 feet by 2 feet 10 inches, and the whole, including the glass roof, covered with polythene film 0·0002 inch in thickness. Patent staples driven in with a staple machine made an ideal job of fixing the plastic film to the wooden sash bars. This completely sealed the compartment from the outside conditions, the only time air penetrated was through the door when it was necessary to enter.

The mist spray equipment was installed over the west bench, the east bench being reserved for another experiment of rooting cuttings under polythene plastic film within a plastic lined house. This west bench is 14 feet long, approximately 3 feet wide, 3 feet high from the floor, and 1 foot 6 inches from the water gutter, and is served with heat from 4-inch hot water pipes.

No. 2 Unit. This outside unit resembles a barn-shaped tent 6 feet long, 4 feet wide and 3 feet high and runs east to west. The whole structure is covered with polythene film 0·0005 of an inch thick, and stapled to the surrounding bottom board which is 4 inches in height, one side fixed in such a manner as to enable the plastic side to be rolled or lifted up, making easy access to the inside of the propagation unit (Fig. 138).

No. 3 Unit. As the two mist propagating apparatuses at Wisley both operate under a covering of polythene plastic film a third unit is now installed in the propagating house immediately south of No. 1 Unit. It is proposed that in this experiment the intermittent mist technique will be used on cuttings of notoriously difficult rooting subjects in full sun with only the glass as covering. The effect of extra bottom heat as an aid to quicker rooting will also be explored. Next spring it is hoped to erect a fourth unit and carry out experiments in the open, probably demanding a continued mist technique apparatus.

The Dutch growers reserve moisture on their cuttings by their double glass ("sweat frames") method where the many water drops on the glass are encouraged, and the cuttings are inserted well up almost touching the inner glass. Under these conditions with only a weekly inspection for the removal of decayed and diseased leaves the Dutch growers work wonders in plant propagation.

It appears that the old idea of sending the garden boy to the propagating house to open up the case each morning to sponge off the moisture from inside the glass and to leave the lights open for an hour or even more to dry out the frame is utterly farcical.

CUTTINGS

Although a great advantage can be obtained in the installation of a "Mist Technique Propagator" for the increase of plants the experienced plantsman with a wide knowledge of plant life will always be more successful in obtaining better results than the inexperienced person. The correct selection of cuttings will still be of paramount importance. Experience has proved that with the aid of mist, growers in future will be inserting cuttings (especially of hard wooded ornamentals) at a much earlier season of the year when the wood is really soft. Such cuttings under the mist technique root very quickly, and can be potted up and become well established before the autumn.

With this type of cutting such essential matters as the collection of large leafed evergreen cuttings early in the morning when the tissues are fully turgid, and at the same time placing the cuttings immediately into a plastic film bag or into airtight tins protecting the cuttings from drying winds and bright sunshine remains most important. The right strength of cuttings, proper watering in, and correct shading facilities will still be necessary to get the utmost returns from "Intermittent Mist Propagation". However, it is safe to say that the inexperienced plantsman would obtain a far greater percentage of successful rootings with the aid of mist than he would under the normal practice.

Under mist culture there is not the same necessity to obtain the balanced cutting. Mist technique prevents the evaporation of moisture from the leaf, thus sustaining the cutting in perfect turgidity until it is rooted. At Wisley results show that magnolias, especially the *soulangiana* group, respond exceptionally well to this form of propagation. Cuttings of young wood 12 to 15 inches in length root equally as well as the balanced cutting 4 to 5 inches long.

Very soft cuttings of camellias and the larger leaved hardy rhododendrons, developed blackleg and damped off within a week, but semi-hardwooded cuttings of camellias rooted 95 per cent.

A very high percentage of the smaller leaved rhododendrons seem to root easily from the softer wooded type of cutting but at Wisley no success has been obtained yet in rooting the hardy hybrids, i.e. 'Pink Pearl', 'Mars', 'Mrs. Furnivall', 'Mrs. G. W. Leak', 'Britannia', 'China', 'Glory of Littleworth' and such-like varieties. This can probably be attributed to several causes:

1. Lack of good bottom heat.
2. No aid from growth substances.
3. Lime content in the water supply.
4. Too heavy water spray causing leaching of the foliage.

With very soft cuttings which root readily often within a fortnight of insertion, a nozzle producing larger droplets of water can be very successful providing there is ample drainage and a good porous rooting medium but with semi-hard cuttings, which may take three or more months to root, it is a different matter. In this case a truly atomized

spray is necessary to throw a mist of water in such a manner as to wet completely the entire leaf surface with as little water as possible. Constant heavy spraying of months is apt to cause leaching of the cuttings making the leaves turn yellow through the breakdown of the green leaf matter (chlorophyll), thus resulting in leaf dropping. This was especially noticeable with cuttings placed in the Wisley outdoor plastic unit situated in full sun with no shading. Too heavy spraying will also lower the temperature of the rooting medium. This may not be of extra importance in sunny midsummer when conditions within the propagator are almost tropical-like, but during wet, dull periods, and towards the late autumn, it can be most detrimental. A very important factor to remember with the rooting of cuttings under mist technique is that cuttings generally root quicker when the temperature of the rooting medium is higher than the temperature surrounding the stem and foliage of the cuttings. To date Wisley has no results to record of the propagating of difficult rooting subjects under mist technique with well organized and controlled bottom heat.

Densely hairy leaved plants, especially the silver leaved types, have proved most difficult to root from cuttings inserted under mist technique conditions, the continued moisture on the foliage destroys all the hair formation, subsequently resulting in the death of the cuttings.

The selection of suitable material for rooting remains the most important operation in vegetative propagation. This may entail the growing of difficult-to-propagate plants under more congenial conditions within a greenhouse to get the necessary growth for rooting.

SHADE

To shade or not to shade—opinions differ, but at Wisley with mist propagation under glass we have found it beneficial to shade cuttings during exceptionally hot sunny periods when the sun is at its highest. On the other hand cuttings in the airtight outdoor plastic tent (unshaded) received no scorching from truly brilliant sunshine provided the intermittent spray operated perfectly. Should trouble crop up with choked nozzles, electrical faults, or water troubles, heavy shading is advised until everything is again in working order. Serious damage to the extent of a total loss can be experienced should the apparatus fail to function allowing the leaves of soft wood cuttings to become dry during sunny periods. DR. J. FLOOR maintains that lack of light prevents full formation of carbohydrates thus delaying root formation, whereas experiments at East Malling with a covering of coco-nut string matting of $\frac{3}{8}$-inch square mesh, reducing the light intensity almost by half, gave excellent results in their outdoor unit.

At Wisley successful experiments proved that the conditions created under mist technique enabled a larger amount of leaf surface to remain on the cuttings, resulting in equal, if not better and quicker, rooting percentages.

In districts where the available water supply is distinctly calcareous,

continued mist spraying would tend to neutralize strong acid media, to the detriment of the ericaceous group of plants.

GROWTH SUBSTANCES

Research has shown that there is a tremendous variation in the reaction of various cuttings to growth-promoting substances, for whereas some plants are quite unresponsive to chemical treatment others show an appreciable benefit. The majority of cuttings taken very soft from numerous ornamental trees and shrubs rooted so easily under mist treatment that at Wisley no assessable difference could be recorded. The more obstinate varieties or difficult-to-root cuttings benefited from growth substances. All such cuttings were dipped momentarily as soon as prepared into the powdered substance and inserted immediately into their rooting compost.

COMPOSTS AND CONTAINERS

The importance of rooting composts for many of the quickly rooting soft cuttings is slightly minimized with cuttings which root within a fortnight under mist technique. Good sharp sand provided with absolutely perfect drainage will be found quite suitable. The best possible drainage is of paramount importance at all times in "Mist Technique Propagation".

At Wisley all cuttings the first season were inserted into pots, pans or boxes. These were used because a great variety of different subjects were to be tested, naturally resulting in different rooting periods. When rooted the portable containers made transit easy when the transference time arrived.

The perfect drainage for 4-inch deep boxes is ¼-inch-mesh wire bottom covered with broken crocks. Pots and pans should have one-third of their depth filled with clean crocks. It was found inadvisable to cover the crocks with coarse peat or rough leaf before filling with rooting composts as receptacles so prepared at Wisley tended to become water-logged and (the peat in particular) after a few weeks became decidedly stagnant.

Many mixtures of the following ingredients were used in different proportions to try and find the most desirable medium.

1. Best acid granulated peat.
2. Fine Bedfordshire silver sand.
3. Sharp gritty river washed sand.
4. Vermiculite.

Vermiculite together with equal parts of fine Bedfordshire sand, and river-washed sand proved excellent for general rooting purposes, as did Vermiculite only, but at Wisley we have now settled down to using

1 part fine Bedfordshire silver sand,
1 part sharp, gritty, river-washed sand for the majority of non-ericaceous plants, and

1 part fine Bedfordshire silver sand,
1 part sharp, gritty, river-washed sand,
1 part best acid granulated peat for the acid-peat-loving plants.

TRANSFERENCE

It is easy to understand that cuttings rooted under mist conditions, especially so during the hottest days of the year, cannot be expected to withstand too abrupt and sudden a shift to more open conditions, as soon as sufficient roots are developed. Very soft cuttings continue to grow during the period they are producing roots under mist, and this type of rooted cutting can easily receive a drastic check at this transference stage from mist to more open and drier environment. For the commercial grower dealing in large numbers of plants the best procedure is to pot the rooted cuttings and to return them as soon as possible to the mist bench, gradually decreasing the mist exposure by regulating the spraying apparatus until the little plant has established itself anew.

At Wisley where small numbers are dealt with the rooted cuttings are potted off singly and placed in a "Nursery Tent" within a closed greenhouse for a week or so to harden the soft plants off before more open conditions are introduced.

The tent consists of a simple wooden structure made of narrow battens, and covered with 0·0002 of an inch thickness of polythene film. In this the plants are syringed three times daily thus preventing wilting and scorching and encouraging re-establishment. This technique could be utilized for commercial purposes where large numbers are required, by using a polythene-lined greenhouse, making sure that the plastic film is fixed in such a manner as to allow the ventilation to open and shut at will for the final hardening process, also remembering to keep the young plants syringed with water several times daily until the growth has hardened up.

With semi-hard cuttings, which take much longer to root and are not liable to produce quantities of soft growth, the hardening-off is not so exacting. In many cases the cuttings can be left in the rooting bench until maximum roots have developed.

Cuttings of deciduous plants rooted in late autumn can be left in their rooting positions and hardened off to remain without mist until early spring before receiving further attention, providing the propagating position is not required for more cuttings during the winter months.

The conditions existing under the mist spray are ideal for the growth of fungus disease so that if a disease should appear its spread is likely to be rapid. For this reason we try to take every precaution and believe that any sign of disease should be immediately treated by spraying with Colloidal Copper at half strength. Our mycologist, MR. GREEN, believes this to be the best spray to use and that it could, with advantage, be repeated every ten days giving two or three applications wherever a disease has been observed.

SUMMARY

(1) A properly installed foolproof mist technique unit can be a great labour saver where large numbers of soft-wood cuttings are needed.

(2) Many ornamental trees and shrubs, which have proved difficult to root in the past from semi-hard cuttings, will root freely and quickly under mist from very soft cuttings (see tables attached). Such cuttings, taken earlier in the year, become well established plants by the autumn. Floribunda-type roses, perpetual-flowering carnations (Fig. 139), chrysanthemum and dahlia cuttings all root 100 per cent under mist conditions within three weeks of insertion (see tables attached). The speed of the rooting is governed by the amount of bottom heat used. Artificial bottom heat is essential during the winter and early spring before the sun becomes powerful.

(3) Common sense and care at the transference period—the weaning of the soft rooted cuttings from the tropical humid atmosphere to normal conditions—will minimize losses to nil.

(4) Growth substances in concentrated dust form are easy to apply and are helpful with many notoriously difficult rooting plants, but only weak applications are advised for very soft cuttings. Strong substances easily and quickly destroy the milky soft cuttings under mist conditions.

(5) The correct type of nozzle, which throws a truly atomized spray evenly over the desired area to keep the cuttings covered with a film of moisture the whole time, is essential using as little water as possible. With the larger leaved evergreen cuttings, which take several months to root, this is of the utmost importance to prevent leaching.

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4. Elpreq Horticultural Appliances, 13 Terminus Place, Eastbourne, Sussex; MacPennys, Bransgore, Nr. Christchurch, Hampshire; Burgess & Co. (Engineers) Ltd., Easthampstead Road, Bracknell, Berkshire.
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TABLE I

Rooting of various shrub cuttings under Intermittent Mist. Various viburnums were inserted in April as very soft cuttings and 100 per cent rooted in about 3 weeks in a mixture of coarse sand and silver sand. Large flowering lilacs rooted best as semi-hard cuttings in sand. Floribunda roses rooted very easily in 10–12 days.

Plant material	*Number*	*Type of cuttings*	*Date inserted*	*Date rooted*	*Rooting medium*	*Number rooted*	*Percentage rooted*
VIBURNUMS:							
V. bodnantense	50	Hard heel	26/4/57	17/5/57	1CS, 1SS	50	100
V. opulus aureum	25	Hard heel	26/4/57	24/5/57	1CS, 1SS	25	100
V. tomentosum	50	Hard heel	26/4/57	17/5/57	1CS, 1SS	50	100
V. fragrans. White form	25	Hard heel	26/4/57	17/5/57	1CS, 1SS	25	100
V. dilatatum	25	Hard heel	26/4/57	24/5/57	1CS, 1SS	25	100
V. bitchiuense	50	Semi-hard heel	18/10/56	20/12/56	6CS, 1P	43	86
V. cinnamomifolium	25	Semi-hard heel	18/10/56	15/12/56	6CS, 1P	25	100
SYRINGAS:							
S. josiflexa 'Bellicent'	50	Soft heel	7/5/57	5/6/57	1CS, 1SS	50	100
S. 'Lèon Simon'	50	Semi-hard wood	13/7/56	7/9/56	1CS, 1SS	50	100
S. 'Susie Baltet'	50	Semi-hard	13/7/56	15/8/56	1CS, 1SS	44	88
S. prestoniae 'Grevy'	25	Soft nodal	26/4/57	1/6/57	1CS, 1SS	15	60
S. 'Congo'	25	Soft, with heel	1/5/57	1/6/57	1CS, 1SS	14	56
S. 'Rubra de Marley'	25	Soft nodal	26/4/57	1/6/57	1CS, 1SS	16	64
S. 'Renuncle'	25	Soft nodal	26/4/57	1/6/57	1CS, 1SS	10	40

KEY: SS=Silver Sand; CS=Coarse Sand; L=Loam; P=Peat; V=Vermiculite.

TABLE II

Chrysanthemums were rooted in 14 days in various composts. Dahlias took approximately 4 weeks but 100 per cent rooted with little, if any, bottom heat.

Plant material	*Number*	*Type of cutting*	*Date inserted*	*Date rooted*	*Rooting medium*	*Number rooted*	*Percentage rooted*
CHRYSANTHEMUMS (EARLY VARS.):							
'Carefree'	24	Nodal	5/2/57	19/2/57	1CS, 1P	24	100
'Brenda Talbot'	36	Nodal	5/2/57	19/2/57	3S, 1L, 1P	36	100
'Brumas'	18	Nodal	5/2/57	19/2/57	3CS, 1L, 1P	18	100
'Fred Yule'	40	Nodal	5/2/57	19/2/57	3CS, 1L, 1P	40	100
'Migoli'	18	Nodal	5/2/57	19/2/57	2CS, 1V	18	100
'Perfection'	27	Nodal	5/2/57	19/2/57	2CS, 1V	27	100
'White Wings'	27	Internodal	5/2/57	19/2/57	2CS, 1V	27	100
'Sweetheart'	18	Internodal	5/2/57	19/2/57	V	18	100
'Red Flare'	20	Internodal	5/2/57	18/2/57	V	20	100
'Fiesta'	20	Internodal	5/2/57	19/2/57	V	20	100
DAHLIAS:							
Box A (Small Dec.)	50	Nodal	22/2/57	20/3/57	V	50	100
Box B (Med. Cactus)	50	Nodal	22/2/57	18/3/57	1CS, 1SS	50	100
Box C (Large Dec.)	50	Nodal	22/2/57	17/3/57	3L, 1P, 15	50	100
Box D (Small Cactus)	50	Nodal	22/2/57	24/3/57	SS	38	76

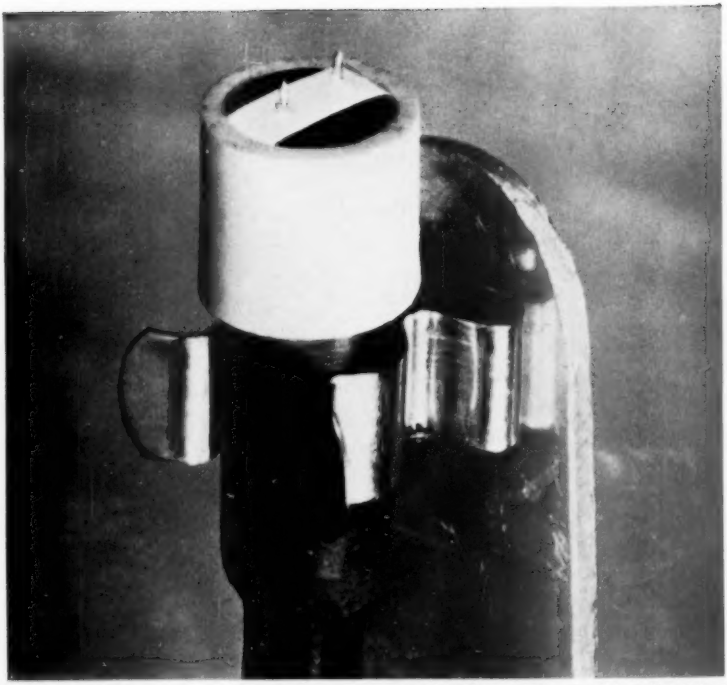
TABLE III

Perpetual-flowering carnations rooted 100 per cent in about a month without any bottom heat.

Plant material	*Number*	*Type of cutting*	*Date inserted*	*Date rooted*	*Rooting medium*	*Number rooted*	*Percentage rooted*
PERPETUAL-FLOWERING CARNATION VARS.:							
'Doris Allwood'	27	Nodal	2/2/57	10/3/57	CS	27	100
,, ,,	27	Internodal	2/2/57	10/3/57	CS	27	100
'Edward Allwood'	30	Nodal	2/2/57	27/2/57	SS	30	100
,, ,,	30	Pipings, stem split	2/2/57	27/2/57	SS	30	100
'Heather Pink'	25	Nodal, stem split	2/2/57	2/3/57	1CS, 1SS	25	100
,, ,,	31	Pipings, stem split	2/2/57	28/2/57	1CS, 1SS	31	100
'Market Rose'	51	Nodal	2/2/57	7/3/57	2CS, 1V	51	100
'Monty's Pink'	28	Nodal	2/2/57	27/2/57	2CS, 1SS, 1P	28	100
,, ,,	25	Internodal, stem split	2/2/57	27/2/57	SS	25	100
'Pelargonium'	50	Pipings, stem split	2/2/57	3/3/57	1CS, 1SS	50	100
'Pink Sim'	68	Internodal, stem split	2/2/57	27/2/57	V	68	100
,, ,,	28	Nodal	2/2/57	3/3/57	2CS, 1V	28	100
,, ,,	39	Pipings	2/2/57	3/3/57	3CS, 1SS	39	100
'White Sim'	50	Nodal	2/2/57	27/2/57	CS	50	100
,, ,,	31	Internodal, stem split	2/2/57	27/2/57	2CS, 1V	31	100
'William Sim'	24	Nodal	2/2/57	27/2/57	2CS, 1SS, 1P	24	100

Photo, T. C. Clare

FIG. 135—Arum lilies growing in the open near Ascot (See p. 491)

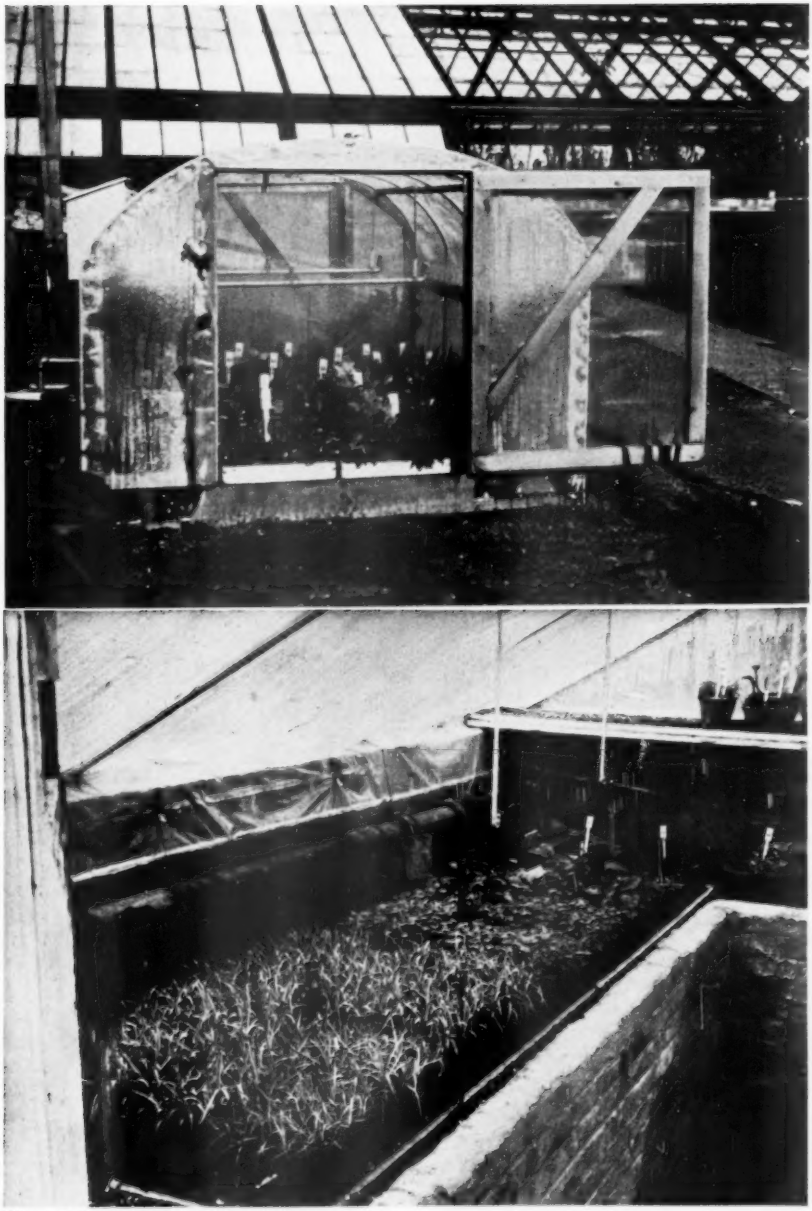


Photos, N.I.A.E.

MIST TECHNIQUE PROPAGATION

FIG. 136—Close-up of "Artificial Leaf" made by the National Institute of Agricultural Engineering (See p. 462)

FIG. 137—The mist controller in action inside the greenhouse



Photos, R. P. Scase

MIST TECHNIQUE PROPAGATION

FIG. 138 (*above*)—A small tent of polythene with cuttings under intermittent mist spray in the frameyard at Wisley (See p. 466)

FIG. 139 (*below*)—Boxes of carnation cuttings under intermittent mist spray in the propagating greenhouse at Wisley (See p. 471)

MIST TECHNIQUE PROPAGATION

FIG. 140—Rooted cuttings of *Caryopteris clandonensis* (See p. 475)

Photos, R. P. Scase

FIG. 141—Rooted cuttings of *Buddleia alternifolia* (See p. 475)

Photo, J. E. Downward

FIG. 142—*Ceanothus impressus* **F.C.C.** April 30, 1957. Shown by the Crown Estate Commissioners, The Great Park, Windsor. Plant against the wall at Windsor (See p. 494)

Photo, Royal Botanic Garden, Edinburgh

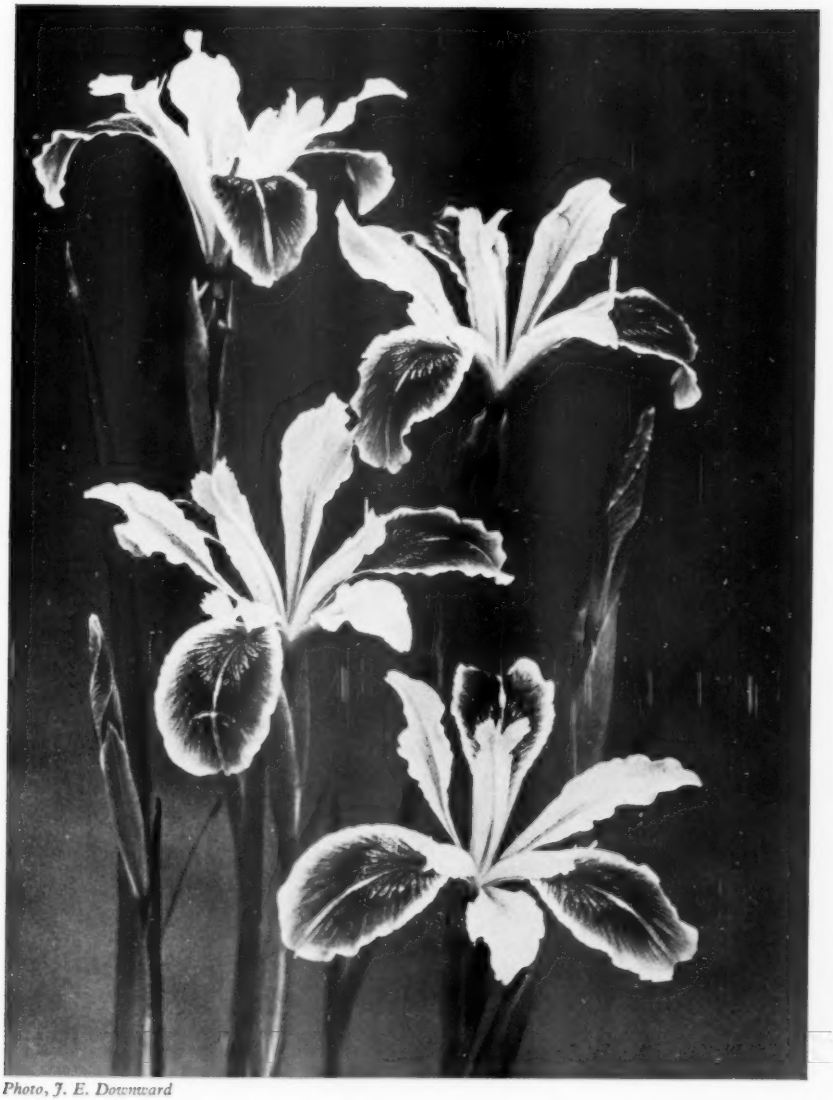
FIG. 143—*Aster tongolensis* 'Napsbury' in June (See p. 492)

Photo, H. C. Pugsley

FIG. 144—*Verbascum phoeniceum* × *V. dumulosum*. Plant 10 inches high, raised by MR. H. C. PUGSLEY (See p. 489)

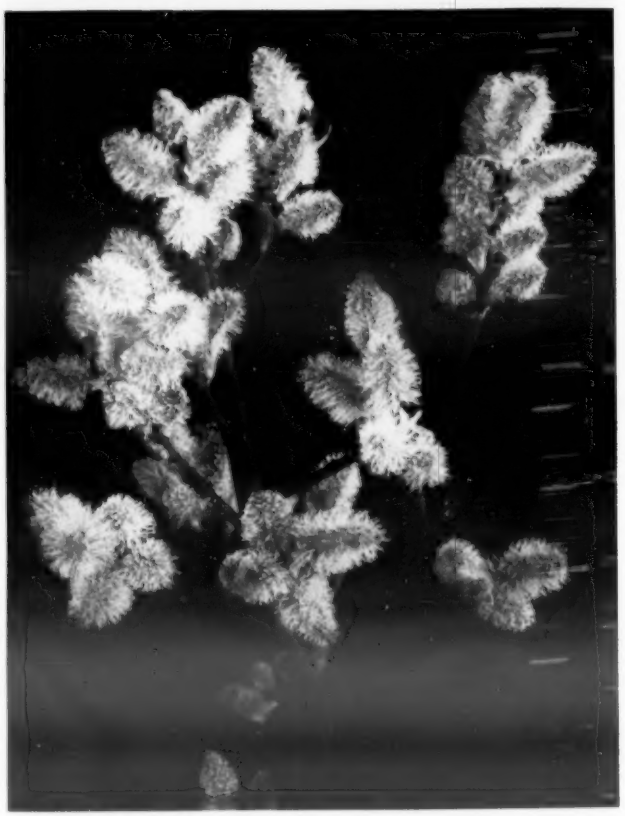
Photo, T. C. Clare

FIG. 145—Fine blooms of *Protea cynaroides*, the King Protea, shown in an exhibit at the Chelsea Show by the City of Johannesburg Parks



Photo, J. E. Downward

FIG. 146—Iris 'Elfin Motley' **A.M.** May 20, 1957. Shown by MR. H. SENIOR FOTHERGILL (See p. 494)



Photos, J. E. Downward

TWO USEFUL WILLOWS FOR WINTER FLOWERING

FIG. 147—*Salix aegyptiaca* (syn. *S. medemii*) **A.M.** January 22, 1957 (See p. 495)

FIG. 148—*Salix daphnoides* **A.M.** February 19, 1957. Shown by the Director, University Botanic Garden, Cambridge (See p. 495)

FIG. 147—*Salix aegyptiaca* (syn. *S. medemii*) **A.M.** January 22, 1957 (See p. 495)

FIG. 148—*Salix daphnoides* **A.M.** February 19, 1957. Shown by the Director, University Botanic Garden, Cambridge (See p. 495)

TABLE IV

Rooting of various ornamental shrub cuttings; the high percentage of the majority rooted satisfactorily but very soft cuttings of camellias died within a week. A very low percentage of plants with silvery or hairy leaves was rooted.

Plant material	*Number*	*Type of cuttings*	*Date inserted*	*Date rooted*	*Rooting medium*	*Number rooted*	*Percentage rooted*
Ceanothus 'Gloire de Versailles'	50	Semi-hard	23/10/56	20/12/56	6CS, 1P	25	50
Buddleia alternifolia	150	Soft heel	3/5/57	30/5/57	1CS, 1SS	150	100
Weigela florida	50	Soft heel	7/5/57	24/5/57	1CS, 1SS	50	100
Olearia scilloniensis	50	Soft heel	7/5/57	2/6/57	1CS, 1SS	50	100
Philadelphus magdalenae	50	Soft heel	7/5/57	20/5/57	1CS, 1SS	25	50
Camellia japonica hybrids	10	Very soft nodal	30/3/57	—	2CS, 1P, 1SS		
Cornus florida rubra	50	4″ soft wood	26/6/56	24/7/56	1V, 1SS	50	100
Variegated holly	50	4″ soft wood	9/7/56	3/9/56	1V, 1P	43	86
Magnolia soulangiana alba	50	4″ soft wood	23/7/56	7/9/56	3SS, 1CS, 1V	41	82
,, *stellata*	50	4″ soft wood	23/7/56	20/12/56	1P, 1SS	40	80
Acer palmatum	50	4″ soft wood	22/6/56	3/9/56	1P, 1CS	9	18
Azalea hybrids	50	4″ soft wood	22/6/56	6/9/56	2CS, 1P	25	50
Rhododendron 'Sapphire'	25	Semi-hard heel	7/11/56	10/1/57	1SS, 1CS, 1V	12	48
,, *imperator*	50	Semi-hard heel	5/10/56	5/2/57	6CS, 1P	50	100
Senecio laxifolius	50	Soft with heel	1/5/57	4/6/57	1CS, 1SS	13	26
Santolina neapolitana	50	Soft nodal	1/5/57	30/5/57	1CS, 1SS	26	52
Lonicera fragrantissima	50	Hard with heel	1/5/57	24/5/57	1CS, 1SS	50	100
Kolkwitzia amabilis	50	Soft with heel	1/5/57	30/5/57	1CS, 1SS	48	96
Deutzia wilsonii	50	Soft nodal	1/5/57	20/5/57	1CS, 1SS	50	100
Caryopteris clandonensis	175	Soft nodal	2/5/57	12/5/57	1CS, 1SS	175	100
Hypericum patulum	75	Soft nodal	2/5/57	15/5/57	1CS, 1SS	75	100

MASTERS MEMORIAL LECTURE, 1957

THE WATERING OF FIELD AND GLASSHOUSE CROPS IN THE UNITED KINGDOM

E. J. Winter, M.C., M.Sc.
(National Vegetable Research Station)

(*Lecture given on September* 24, 1957, MR. F. A. SECRETT, C.B.E., F.L.S., V.M.H., *in the Chair*)

PART I

THE CHAIRMAN: The Masters Memorial Lectures were established by means of funds received in 1908 to commemorate DR. MAXWELL MASTERS, Fellow of the Royal Society, for the purpose of bringing to the notice of the gardening public the results of scientific research and their application to practical horticulture. A Lecture is given each year. Our lecturer this afternoon will be dealing with one part of his Lecture, and the second part will be given on November 5. MR. WINTER, is very well known to me and, I expect, to many of those present because of his research work at the National Vegetable Research Station at Wellesbourne.

My mind goes back a number of years to the beginning of the war when I gave a lecture on horticulture in peace and war to the Farmers' Club. In the lecture I made the statement that England had no vegetable research station with the exception of an eight-acre field attached to Cambridge University which was entirely given to the production of strawberries. MR. HUDSON, who was then Minister of Agriculture, sent for me and asked me if that statement was true, remarking, "If that is correct, SECRETT, I will approach the Treasury immediately to ascertain whether they will allocate some money to establish a National Vegetable Research Station". That was the beginning.

We had difficulty in finding land, but land was found, and now the Station is being developed under the Directorship of DR. PHILP. They have done wonderful work for the vegetable industry. How many years have you been there, MR. WINTER?

MR. WINTER: Since 1949.

THE CHAIRMAN: They are not only working on irrigation there, but are doing a considerable amount of plant breeding, and they are also studying the question of weedicides and insecticides. As a member of commercial horticulture, I can truthfully say that we have received very great benefit in these few years from the work which has been carried out at Wellesbourne.

MR. WINTER has been engaged in these irrigation investigations, a subject in which we are all interested, even in this dripping climate. There are periods when we really want a little more water. MR. WINTER is the greatest authority I know of today on the question of the application of water, and I am very grateful to him for coming along.

MR. WINTER: The only stage in the life of most ordinary plants during which some external supply of water is not essential is the dormant seed, corm, tuber, or other resting stage. As soon as active growth starts, a supply of water is essential for its continuance and for the maintenance of life itself. Indeed the presence of external water is one of the stimuli which combine to break dormancy and cause growth to begin. (These generalizations apply to ordinary crop plants; there are many exceptions among plants adapted to surviving long or short periods without external water supply.)

The source of water is usually the soil or other medium surrounding the roots, though some epiphytes (e.g. orchids) can obtain water directly from the atmosphere, while certain parasites (e.g. mistletoe, dodder) absorb moisture from the tissues of their hosts. Many plants can take up water through their foliage and DUVDEVANI (1) has demonstrated improved growth of plants by their making use of dew in this manner. He has also shown that under certain circumstances plants having absorbed water through their leaves can excrete the excess into the soil immediately surrounding their roots, presumably re-absorbing it when conditions alter. The ability to make use of dew is unlikely to be of importance in this country where dewfall is only about 1 per cent of the annual precipitation (2). In arid zones of the Middle East however, stones are piled round the bases of plants such as vines, where they apparently form collecting surfaces for useful quantities of dew.

The quantity of water taken up by plants is often a matter of surprise to the layman. For example, an acre of cauliflowers in full sunshine takes water from the soil at the rate of about 2–3,000 gallons per day; a single cauliflower plant can use about a quarter of a gallon of water on a sunny day. In the glasshouse the volume of water taken up by pot plants is reduced because of the high ambient humidity and absence of wind, but the overall water consumption is considerably increased by evaporation from the surface of the pots.

Only an infinitesimal part of the water taken up by a plant in its lifetime is incorporated in its tissues. The bulk of the water is used as a medium of nutrient transport, and as a means of maintaining the turgidity of the whole plant. Some plants excrete a small volume of liquid water through special pores, but most of the water is lost in the vapour phase by transpiration through the stomata. The large amount of energy needed to convert the liquid water into vapour is obtained from the sun. Measurements at Wellesbourne on a sunny June day showed that energy equivalent to about 6 kilowatts were falling on each square yard of vegetation; of this about half was utilized by the

plants in the transpiration process. The mechanism of this process is not understood. PENMAN has assumed it to be purely physical in his formula by means of which measurements of sunshine hours, run of wind, and air temperature and humidity are used to compute the water loss by evaporation and transpiration from uniform green areas of vegetation to which the water supply is not limiting (3). The formula does not take into account the kind of plants, their stage of growth (except that they must be completely covering the soil) nor the kind of soil beneath them. Nevertheless, although most biologists would assume that these factors would have some effect on transpiration rate, the Penman formula has been found to work well for estimating the general rate of water loss or evapo-transpiration from the plant/soil system.

Other physical methods of estimating evapo-transpiration have been developed (4) but none has been so successful as the Penman method, which has been modified by many workers for special purposes.

At Wellesbourne, STANHILL has developed the Penman formula for use on a day-to-day basis for specifying the quantities of water to be applied in irrigation experiments. STANHILL has taken into account variations in rate of water loss caused by the crop incompletely covering the ground. Under ordinary market garden conditions, the average ground cover by vegetable crops is only 21 per cent from April to September. Thus a considerable proportion of the water loss under commercial conditions must be by direct evaporation from the soil surface. The rate of loss from bare wet soil equals that from an open water surface, but as soon as a dry crust forms the evaporation rate is reduced almost to nothing. In comparison, the loss from a uniform green crop surface is about 90 per cent of that from an open water surface. Using these figures, it is possible to estimate the rate of water loss from areas of crop which only partially cover the soil.

The Penman method provides a means of assessing water loss from the soil when the water supply to the plants is not limiting the process. Whether the water supply to the plants is in fact limiting under any particular set of conditions depends on such factors as the depth of the plant roots and the soil moisture content. Regular evaluation of these factors is laborious but it has been established that, starting with the soil at field capacity,* about 3 inches of water can be lost from a grass sward before the transpiration rate is reduced by shortage of water (5). Figures for other crops are known with less accuracy. Using such figures a map has been published (6) showing the frequency of "irrigation need" in various parts of England, i.e. the number of years in ten when average evapo-transpiration exceeds average summer rainfall by more than 3 inches.

The use of the term "irrigation need" implies that, provided the transpiration of crops is not checked by shortage of water supply, their growth rate and yield will also be unaffected, but this assumption is

* A soil is said to be at field capacity when it is holding its maximum possible volume of water against free drainage.

probably not justified. SALTER, (7) for instance, has shown that the highest yield of glasshouse tomatoes was obtained when the plants were grown under continuously wet conditions, and that the build-up of even a small soil moisture deficit* was accompanied by a reduction in yield.

Under ordinary gardening conditions the soil moisture status is more often than not below field capacity. Furthermore, in summer, water supplies in most parts of the country are limited; reserves are dwindling, and it becomes important to know which crops can be left to grow under natural, more or less dry, conditions and which crops must be irrigated in time of drought if they are not to suffer loss in yield or quality. Much of the irrigation research at Wellesbourne is directed towards answering this question.

VEIHMEYER, in his review of a large number of experiments (8) concluded that water was equally available to plants (and that therefore plant growth was not limited by water shortage) until the permanent wilting point was reached. Few biologists now accept this view, and among others, SALTER has advanced convincing reasons why VEIHMEYER should have been misled by his results (9). It is now usually accepted that the availability of the soil water to plants decreases with increasing deficit, and a second objective of current research is to determine what proportion of the available water in the soil can be lost before growth rate, yield or quality of the crop is adversely affected.

The soil moisture content in a crop/soil system cannot remain constant. Water is continually being removed by evaporation and transpiration, and the soil moisture content falls until more water is applied—usually to the soil surface. When soil is watered, a layer becomes saturated the depth of which depends upon the amount of water applied. When the application of water ceases, downward movement of water continues until the moisture content of the whole wetted zone reaches equilibrium at field capacity. Under natural conditions the extent to which the soil dries out before each fall of rain varies. Under glass however, the permitted deficit can be controlled accurately and the resulting procedure constitutes a true soil moisture regime. With field irrigation the best that can be achieved is to limit the maximum permitted deficit by means of irrigation, but casual rainfall may restore varying depths of the soil to field capacity before the desired maximum permitted deficit has been reached on each drying and wetting cycle.

Plants remove water only from the soil immediately surrounding their roots; upward and lateral movement of water in the soil is almost negligible. As the roots extend deeper into the soil, the zone to be restored to field capacity at each watering increases in depth. This does not affect the general working of the Penman concept, however, because the volume of water needed to restore the root zone to field capacity equals the volume removed from the soil, irrespective of the depth of the soil layer from which it has come.

* SALTER expressed his results in terms of soil moisture tension, but increase in tension is perforce the accompaniment of increase in deficit.

Field capacity and permanent wilting point* vary in different kinds of soils; in consequence the amount of water available to plants also varies, and a given Penman deficit may represent the loss of a different proportion of the available water in different soils. If it is accepted that the soil water is not equally available to plants throughout the available water range, it follows that the same Penman deficit may impose different soil moisture stresses upon plants in different soils. Results of preliminary experiments on cauliflowers by the Wellesbourne workers support this hypothesis and further work is proceeding to ascertain its practical implications.

The general principles relating to the water requirements of plants—the application of water to the soil, its uptake by plants and loss by drainage evaporation and transpiration—are fairly well understood, though they are by no means universally applied in practice. The largest gap in our knowledge concerns the effects of variation in soil moisture stress on individual crop yield and quality; from the point of view of economy in water, irrigation equipment and labour it is of paramount importance to know when plants will suffer no harm from being left unirrigated, and when replacement of the soil moisture is essential to avoid loss of yield or quality. These biological aspects of the subject and their application in practice will be discussed in the next lecture.

THE CHAIRMAN: We have listened to a very interesting lecture. In the case of the commercial gardeners, up to the present our approach has largely been an empirical one in respect of the irrigation of our soils.

I was delighted to hear MR. WINTER refer to the need for keeping a dust tilth.

There was another point in which I was very interested, and no doubt we shall hear more about it when the next part of the lecture is given. It is the question of foliar feeding, which I am convinced answers a good many of our problems.

I was very glad to hear MR. WINTER refer to the question of dew. Dew is different from rain water, as all of us who have been in close contact with the soil know. We still have a lot to learn of the effects of dew upon our plants, and I am very glad that that is being investigated.

MR. WINTER referred to the application of water to the soil without making any reference to cultivations, and I hope there will be some questions afterwards on that aspect.

MR. WINTER spoke of maintaining the optimum amount of water in the soil which is necessary for the plant. But at present we do not know what the optimum amount is. On the other hand, those of us who have been carrying out irrigation over a number of years have realized that if we irrigate a soil which has a hard pan and has not been properly culti-

* A soil is said to be at permanent wilting point when plants growing in it can no longer take up water for growth. They wilt and can be made to recover only by watering the soil—not by saturating the atmosphere around them.

vated, then in all probability we shall lose our water much quicker than we should from a properly cultivated field.

My experience with the application of water has been that, provided that before irrigating I plough and sub-soil and then apply my water and after that keep a dust tilth, the water applied does not evaporate as quickly. I am convinced that sub-soil waters, provided you have a friable sub-soil, are attracted by water which has been applied to the surface of the soil to a depth of 9 to 10 inches and when you have immediately created a dust tilth. I believe you are then drawing upon a lower water supply.

It may seem rather foolish of me to add my comments to the lecture like that, but I know that there are a number of people in the hall who have much information which they could give us.

MR. WINTER: Perhaps I might first answer the Chairman's remark about the attraction of water by water already applied to the surface. There is evidence of a certain amount of movement of water upwards by capillary action, but it is only a comparatively small amount. I think that what has happened on your land, MR. SECRETT, is that you have applied water to the top 9 inches and brought them to field capacity, which enabled your plants to become established. You had cultivated down below, and when they had used the water in the top 9 inches the roots were able to seek water from the lower layers. I think that is how the water is brought up. I do not think it moves on its own.

MR. COHEN (Sutton): What are the physical conditions which make for the greatest amount of capillary attraction?

MR. WINTER: That is a very difficult question to answer. I suggest that in grower terms the principal physical condition is a good tilth. In other words, you will not get much capillary action if you have MR. SECRETT's hard pan. That is one of the reasons why one does deep cultivation, to break up the soil so that you have a large number of air spaces between the particles for the water to move up. In other words, you have a lot of channels. There are several other considerations. The more organic matter, within reason, that you can get in the soil, the better it is, because it will increase your field capacity, and that in itself means that there is more water there to move about. I think that the actual physical conditions which cause the greatest upward movement are concerned with cultivation and all the processes which give you a good tilth.

MR. COHEN: Meaning "more humus"?

MR. WINTER: More humus, and cultivation too.

DR. LAKE (Wrest Park, Bedfordshire): MR. WINTER mentioned two functions of water in a plant. I have always been under the impression that there is a third function which he did not mention, and it is perhaps the most important one. He mentioned that the water carried nutrients up the stem and also kept the plant turgid so that it could stand upright. Has not the water another function, that of keeping the leaves at a reasonably equable temperature?

MR. WINTER: Yes. If one did not have water evaporating from the leaves, they would not stay cool or turgid and the plant would die because it did not get its nutrients. If any one of the processes were stopped there would be interference with the economy of the plant. I agree with DR. LAKE that the function of water in keeping the plant cool is an important one. Whether it is more important than the others I would not know. I am grateful to DR. LAKE for calling attention to the point.

MR. MORRIS: I wish to ask MR. WINTER a question about his comparison between water loss in the open and water loss under glass. He gave a figure of 58 per cent of solar energy in relation to the water loss in the open and stated that the water loss under glass could be expected to be less than that. At Wrest Park we have measured water losses greater than that value under glass—on a weighing machine, and at the Fairfield Station there has been a measurement of water loss of up to 70 per cent of solar radiation. Has MR. WINTER considered the physical aspects of the problem and tried to work out the water losses? It is difficult to account for a water loss of more than 50 per cent due to solar radiation. Yet we are measuring something which is far greater than that. Can MR. WINTER throw any light on the problem?

MR. WINTER: It is often forgotten that the plant is a living organism, and those of us who are biologists like to think that there is something about a living plant which makes it different from a mere bundle of chemicals. I am not suggesting that this will account for all the discrepancies which you point out, but we cannot consider only the physical aspect of the matter. There are biological processes going on and I am sure that when we understand them better we shall be nearer to getting the theoretical answers from water loss studies.

With regard to the first point made by MR. MORRIS about water losses in the greenhouse as compared with the water losses in the open. At Wellesbourne we are concerned, officially, only with irrigation in the open air, and are not concerned with glasshouse irrigation except in so far as it is incidental to some of our investigations. The figure of 58 per cent which I gave for the amount of energy used by the plant was one which DR. STANHILL has produced, and I think it is agreed to by others. The reason why I said that plants probably use less water in a glasshouse is simply that the humidity there is higher and there is no wind blowing round the leaves. For these simple physical reasons alone one would expect less transpiration to take place there. We have no figures to support that statement. The overall use of water by pot plants in the glasshouse is higher because one habitually gives them more water than is necessary, watering them so that some of the water comes out of the drain hole; there is also loss from the sides of the pot itself. These however are not the reasons for MR. MORRIS's higher figures for water loss, which are at present unexplained.

THE CHAIRMAN: It merely remains for me to thank MR. WINTER on your behalf. As I indicated at the commencement, he is at the head of

the Irrigation Department at the Wellesbourne Vegetable Research Station. We have learned a lot from the information which he has given us this afternoon. It is evident that much more investigation must take place before we have the full knowledge which we are seeking. This talk has stimulated me.

On behalf of the Council, I thank you very much, MR. WINTER, for giving us the first part of your Masters Memorial Lecture.

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CHANGING FASHIONS IN ROSES

Gordon Rowley

(*Based on a lecture given August* 13, 1957, SIR FREDERICK STERN, F.L.S., V.M.H., *in the Chair*)

THE wayward child of fashion has long influenced the popularity of our garden flowers. New introductions from foreign parts, new "breaks" in breeding create a vogue: high prices are paid for novelties, and previous favourites go into decline or even become extinct. In such cases survival depends on longevity and ability to withstand neglect: two attributes of *Rosa* responsible for the persistence of so many "missing links" today. Sometimes a vogue is quick and dramatic, as the tulip mania of the 1630's; sometimes slower and more general, like the "greenery-finery" epoch of Victorian sitting rooms, with their palms, ferns, ornamental gourds and other foliage plants. It is tempting to see in such fashions a reflection of current trends in art. Heavy colourings and intricate leaf embroidery are as much a part of nineteenth-century house decoration as are the sparse contours and neat, compact habit of succulent plants in the suburban residence of today.

Yet art alone is not the only arbiter in deciding which plants will be ticked in a seedsman's catalogue, or which sections of a flower show will be most hotly competed. MR. W. T. STEARN has ably summarized the close link between popular flowers and facilities for their cultivation. A new development in gardening practice may bring to the fore some plant or group of plants that has long languished through inability to grow it. The development of glasshouses and methods of heating them—in particular the degree of humidity provided—coincides with peak periods for succulents, orchids, *Ericas*, pineapples and so on. The present-day popularity of succulents is traceable to both trends: the artistic, because they blend with modern tastes in house decoration, furniture and, I am tempted to add, music, and the practical, because they tolerate so well the dry, light conditions of centrally heated rooms and the amateur's small glasshouse.

So far I have been considering favouritism for existing types of plants. More rarely does fashion call forth the flower. A designer of ladies' dresses knows that his range and colour of materials is almost unlimited, but ultimately they must all be cut to fit the same mould. He cannot influence the shape of the model (thank goodness!). For the Faths and Diors of the floral world, however, the position is rather different. The materials are limited by what Nature, in all her perverse unpredictableness, provides, or can be made to provide by the skill and ingenuity of plant breeders. But the mould is not immutable. One can play to existing tastes, producing for instance Hybrid Tea roses in yet new shapes and shades, or strike out on new lines and endeavour to win

public favour for roses fitted to different aesthetic and cultural niches—the shrub roses of WILHELM KORDES, the miniatures of PEDRO DOT. The current revival of interest in old-fashioned shrub roses is in part due to the realization that they are not merely inferior competitors to the Hybrid Teas and Floribundas, but are plants of a different nature and suited to totally different garden purposes. (4)

Roses have always been popular garden plants, and their history in cultivation goes back further than written records. (5) They have had their ups and downs, of course, but never became eclipsed in popular favour. Man's first attraction to plants was through an empty stomach rather than an eye in search of beauty. The sweet-fleshed red hips of a dog rose would have appealed to him more than the surpassing loveliness of its five-petalled flowers. Later he came to test its roots, twigs and leaves as medicines or charms, with results that can be read—if not believed—in the herbals of DIOSCORIDES and PLINY. By this time the scent was noted and esteemed, to an extent made familiar by the much-quoted accounts of Roman banqueting halls strewn a cubit deep in rose petals. The purely ornamental use of roses as garden shrubs, we see, was slow to come to the fore. Pre-renaissance gardens of monasteries and manors in England grew several roses for ornament, red and white, single and double, together with the wild dog rose and sweet-briar. The development of grafting and budding from the seventeenth century onwards gave impetus to the spread of newcomers like the Cabbage and Moss roses, which produce no seed and are slow or difficult from cuttings.

This increasing reliance on borrowed roots was the first step to set off the rose as a flower from the rose as a self-supporting garden shrub. The gulf became widest with the "exhibition mania" of about sixty years ago. In this phase of fashion little regard was paid to anything outside the appearance of the flower on the exhibition table: it became merely a vehicle for the cultural skill of rival specialists. One is reminded of the animal heads hanging on the wall of the country mansion, and the little boy's request to "go round the back and see what the rest of the animal is like".

A reaction set in, and more and more attention came to be paid to roses of good constitution suitable for general garden use. This has been stressed in the recent attempt to add disease resistance to the make-up of every new rose. It is interesting to compare the criteria for perfection in rose blooms as given by, for example, SHIRLEY HIBBERD in 1894, (1) with those prevailing today. Then the ideal form was globular, with many petals densely imbricated to conceal the centre. The flat, quartered bloom of the Damasks and early Hybrid Perpetuals like 'Souvenir de la Malmaison' had fallen into disfavour, but the love of tall conical centres and the transfer of interest to the opening bud form had not yet come in. A finer analysis of the ups and downs since 1815 can be made from Text Fig. 1. This shows the totals of new rose introductions for each five-year period, ending with 1955. The figures are obtained

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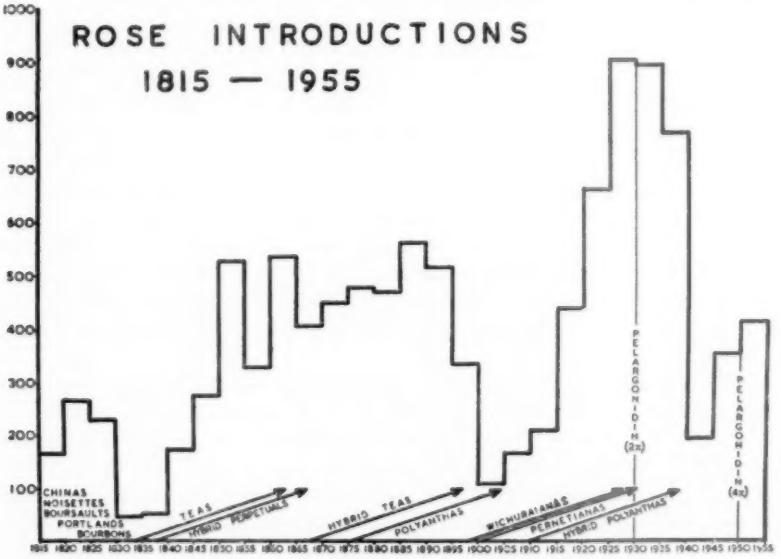
from *Nomenclature de tous les Noms de Roses* (Simon & Cochet), "Modern Roses" and "New Roses of the World" in the American *Rose Annuals*. The first peak from 1820–30 coincides with the first products of hybridization between roses of Europe and the Far East, and with the stimulus to their production given by THE EMPRESS JOSEPHINE at Malmaison. Thereafter the development of the Teas and Hybrid Perpetuals ushered in a second and greater wave of popularity covering the second half of the nineteenth century. The influence of the Hybrid Teas and Polyanthas was not really felt until after 1900, when they were joined by other important groups: the Wichuraianas, the Pernetianas and the Hybrid Polyanthas. The 1939–45 war naturally caused a sharp drop in



TEXT FIG. 1

new introductions and recovery has not yet approached the two-hundred a year of the pre-war peak years. We trust it never will. May the finer-meshed sieve of the Trial Grounds spare us such an *embarras des richesses*.

It would take many words to explain the diversity of forms found among old and new garden roses: it is far simpler to study them in a garden where both types are grown, or one specially planned in chronological beds to show rose fashions through the ages. (3) The size, shape and folding of petals, their colour mosaic, the profile of bud and flower, and the overall effect grouped and seen against the background of foliage are infinitely varied. At different times more value has been placed on one character than on another. Let us take a single character and examine it in a little more detail: colour. Wild rose species run the range from white through cream to buttercup yellow, and from palest pink

through scarlet to deep purple. In chemical language we should say that they have cyanidin (giving pink, scarlet and purple shades) and flavones (giving the yellows). Up to about 1930 the whole range of garden rose patterns came about through combinations of these pigments: the orange and bicolour effects by mixtures of both types, the pure and unfading clear hues by selective breeding. With the introduction of the Dwarf Polyanthas 'Gloria Mundi' and 'Paul Crampel' came the first real innovation in rose colours: a geranium red caused by pelargonidin, a pigment unknown in any wild rose. To be pedantic one could say that the "red, red rose" of which poets sang for centuries was an imaginative ideal: the old roses were all crimson or scarlet, and a true red rose was not seen until long after the Romantic era of art had gone forever.

'Gloria Mundi' and 'Paul Crampel' are diploid roses, and it was a further twenty years before pelargonidin turned up in a tetraploid rose on the right polyploid level for general introduction into the Hybrid Tea and Polyantha groups (Text fig. 1). This was in KORDES' 'Sondermeldung' (or 'Independence' as we know it) which contains a mixture of red pelargonidin and scarlet cyanidin to which the former is closely related. Two years ago in MR. DICKSON'S nursery in Northern Ireland I spotted a Floribunda-type seedling (his 288/53) the colour of 'Paul Crampel', and analysis proved it to contain pelargonidin and nothing else. So finally we have the new colour pure and ready for mixing into the palette of future garden roses.

The more chemically minded among us will appreciate how closely allied are the two pigments, cyanidin and pelargonidin, the mere loss of one hydroxyl (—OH) grouping sufficing to convert the former into the latter. A similar change in the opposite direction—that is, the gain of an extra hydroxyl group—would produce delphinidin, the answer to all our cravings for a true blue rose. How near, and yet how far! Chemists could have predicted the appearance of pelargonidin one day in *Rosa* by a study of the enzymes and basic materials necessary to synthesize it, but there is no evidence yet that those needed to produce delphinidin exist in the genus at all. In this respect *Rosa* is no different from most other genera of flowering plants: it is quite the exception for one genus to cover so wide a range as the yellows, reds and blues. Without delphinidin we can expect no genuine blue roses. True, we can make blue roses by selecting pure scarlet blooms and dipping them in ammonia; a little detergent improves the wetting qualities and the technique can be brought to a fine art although the products deteriorate rather rapidly. But the prospects of breeding them are, to put it mildly, unfavourable. The present efforts by selecting for lavender and mauve shades are merely going after rabbits with a dead ferret: cyanidin by itself stops short of a real blue colour.

Better hopes of innovation come from *Hulthemia*, a genus closely allied to *Rosa*, which contains the gene for bicolour petals. (2) This behaves as a simple dominant, as is shown by its one and only hybrid with *Rosa*, × *Hulthemosa hardii*, which, brought to the tetraploid level, would offer interesting prospects of eye-spotted and multi-coloured

roses. The problem here is purely a technical one of breeding from refractory material, but I am confident that one day this will be overcome. How far such novelties would be an improvement or mere curiosities, like the green rose, I cannot predict. Perhaps we should end up agreeing with GOLDSMITH that "... while fashion's brightest arts decoy, The heart distrusting asks, if this be joy".

To summarize, we have seen how garden roses have changed in both use and form from one historical period to the next, sometimes from the introduction of new genes, sometimes from changes in tastes and artistic ideals. The flower can create the vogue, or fashion can call forth the flower. Breeders can reshuffle the same genes to produce new roses to fit the popular moulds, or take the bolder, riskier course of making a new mould and winning public acclamation for it. With a flower so universal, so stereotyped in men's minds as a rose, the second course is difficult. But it cannot be ignored: the demand for novelty is undying, and already we hear complaints that existing groups are "played out" so far as new breaks are concerned.

A glance at the Rose Society's Trial Grounds indicates new fashions in the making. There is the 'Independence' trend, already referred to, pouring the new brick-red pelargonidin shades into the different groups; the 'Peace' trend with gigantic blooms and lush foliage; the 'Masquerade' trend with colour-changing flowers (a legacy from an old China rose of REDOUTÉ's day, incidentally), and many others. There are revivals of old fashions, too: the mauve and lavender hues, the odd striped rose like 'Modern Times' and, as MR. PARK has pointed out, a strong similarity in flower form of some modern Floribundas to the many-petalled, quartered blooms of Malmaison days.

Scientific backing to rose breeding can greatly shorten the time necessary to create such novelties, although it cannot produce novelties *de novo*. But at least we can be assured that there is no lack of raw materials to set rose fashions for many decades to come.

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VERBASCUMS IN THE GARDEN

H. C. Pugsley

VERBASCUMS have been grown in gardens in this country for a considerable time. As far back as 1683 *The Flower Garden* was published and reference will be found to Herb-mullen as follows: "*Herb-mullen*, all the kinds thereof do flower in May or June and they are for the most part raised by Seed: being sowed at the time as other Seeds are, they usually bring forth Flowers the second year; yet the roots of some of them continue two or three years, or more."

In WILLIAM ROBINSON'S day verbascums were considered to be largely plants for the wild garden; while this is still true of some species, thanks to recent introductions plants can be selected suitable for growing in the rock garden, alpine house and herbaceous border.

Verbascum dumulosum and *V. pestalozzae* are both beautiful dwarf species growing about 10 inches high, with densely tomentose leaves, and should be planted in full sun in well drained soil in the rock garden. The hybrid between these species is a very vigorous plant, which may prove a little more hardy in our conditions, but it has not yet flowered with me.

V. dumulosum × *V. phoeniceum* produces handsome free-flowering plants with branched racemes about 12 inches high; these are quite perennial and stand up to wet weather conditions better than *V. dumulosum* (Fig. 144).

Both *V. dumulosum* and *V. pestalozzae* can be raised from seed, which, however, is not produced very freely in wet conditions, or raised by cuttings of young growth taken at the end of June, and treated with a hormone rooting powder. These will produce nice plants in a few weeks.

Verbascum spinosum, a dwarf shrubby plant with small leaves and spines, is a most distinct species for the alpine house or rock garden in full sun. I have not found it possible to cross this with any other species that I grow.

Celsia acaulis, with prostrate rosettes of leaves and almost stalkless flowers, is a plant to be recommended, as also is the hybrid between this and *V. phoeniceum*, in spite of the fact that this hybrid is rather short-lived.

Of the verbascums suitable for the herbaceous border, and for those that fear the plants may be a source of trouble as well as beauty, the following are good varieties that do not in my experience set any seed and are entirely sterile: 'Cotswold Gem', 'Cotswold Beauty', 'Cotswold Queen', 'Pink Domino' (this last said to have arisen as a bud sport from one of the Cotswold Hybrids), *densiflorum* (of nurserymen) and 'Gainsborough'. V. 'Gainsborough' usually grows about 4 feet high, the others nearer 3 feet. The sterility found in these is no doubt due to their hybrid origin, and they all flower over a long period.

V. 'Gainsborough', pale sulphur yellow, and 'Pink Domino', deep rosy pink, look well associated with Belladonna delphiniums.

To increase these sterile hybrids, root cuttings about 2 inches long taken in the autumn or early spring is the answer. I have tried this at other times of the year without any success.

It has been suggested that an entire border could be planted with verbascums; while it is true species can be grown which vary in height from 5 inches to 5 feet or more, and various colours are available, I do not think such a border would be a success, for many fade by midday on hot days, so that it would only be seen at its best in the early morning. *V. phoeniceum* for instance is much better planted in light shade, when its flowers will last, and as it can be obtained in quite a range of colours it is worth finding a place to suit it, but it does seed rather freely.

If *V. phoeniceum* is used as a parent with other species, and the seed sown as soon as ripe, the plants will flower the following year, and this applies even if the other parent is a slower-maturing plant like *V. pestalozzae*.

Over three hundred species of *Verbascum* and *Celsia* are known, distributed over a wide area of Europe, North Africa and into Central Asia, but in this country the few we have apart from *V. thapsus* do not occur wild much farther north than Derby. *V. phoeniceum*, however, does very well in gardens in the cooler, wetter parts of Scotland. The hybrid between this and *V. blattaria* is a showy plant but short-lived.

V. nigrum album is one of the most attractive for the herbaceous border, growing about 3 feet high with a dark centre to each flower; it is a perennial like the other species and varieties except *V. thapsus* mentioned so far.

V. 'Harkness Hybrid', rich yellow, and 'Miss Willmott', creamy-white, are still perhaps as good as any for the back of the border, growing about 5 feet high; both are biennial and the minute seed is produced in great quantity, so this must be removed or the wind will scatter it far.

Among the biennial species the white form of *V. blattaria* is a dainty plant with white flowers and pinkish backs to the petals, the leaves are shiny, and it comes freely from seed.

For those interested in flower arrangement perhaps the biennial *V. bombyciferum* is the most useful (usually sold as *V. broussa*), for it is entirely covered with dense grey hairs and is useful even if the sulphur-yellow flowers drop. Many species make most attractive silvery rosettes of leaves.

The most common wild species in this country, *V. thapsus*, which will flower as late as August, is not to be despised in the wild garden, for its leaves are attractive, but it is very subject to attacks of mildew, which weakness is passed on to its offspring if crossed with other species.

In many *Verbascum* and *Celsia* the individual plants are self-sterile, and this no doubt encourages the production of many natural hybrids

but *Verbascum haenseleri* and *Celsia arcturus* (a half-hardy perennial plant useful in the cool greenhouse and flowering from July to September) are partly self-fertile.

No doubt the best germination of verbascum seed is obtained if it is sown as soon as ripe, but I have had germination after four years when the seed was kept dry in seed packets.

Planting of most verbascum is better done in the spring rather than in the autumn, and they look best in groups of one kind, whether in the mixed border, on the rock garden or in the wild garden; most will flourish well in town gardens, but the woolly-leaved forms are affected adversely in heavily polluted areas.

NOTES FROM FELLOWS

Zantedeschia aethiopica

NOT nearly enough gardeners realize that the common florist's Arum, or to give it its proper name, *Zantedeschia aethiopica* is a first-class marginal aquatic, and hardy as well, under certain conditions. These are to keep the tubers during the winter sufficiently far under water to be below the ice line. In actual fact my plants in their first winter, the hard one of 1956, were frozen solid through a mistake of my gardener, who put the pots just below the winter level of my pond. It is an amazing thing that any survived, as they were a present to me, after having been flowered in the spring in a hot-house.

To any member, who has a lake, whose level varies about six inches to a foot between summer and winter, I would strongly recommend a large planting at the summer water level, so that they become marginal plants at flowering time, and so exhibit their full height, but are still fully protected during the cold season (Fig. 135).

In a formal pond they can either be planted in a large pot, and raised on bricks during the summer, and lowered in the autumn, or, as I do myself, keep them permanently six inches below water level, which has no effect on their growth or freedom of flowering, but keeps them a little dwarfer, than normal; as so much of the plant is under water.

The flowering period is quite a long one in July; as after the main flowers the tubers throw up a set of smaller, or secondary ones. I divide my plants and replant soon after flowering, so that they can become fully re-established before the winter. The compost should be a strong one, as they need a good deal of food. I use a well rotted turfy loam, with plenty of decayed manure underneath, but for those who do not like natural manure in a formal pool because of the algae it is inclined to establish, a good helping of coarse bone-meal and hoof and horn would be almost as good.

T. C. CLARE

Ascot Wood,
Ascot.

Aster tongolensis

This aster has been much confused in horticulture and has, to my knowledge, masqueraded as *A. alpina*, *farreri*, *scouleri*, *souliei*, *bietii*, *yunnanensis* and *subcoeruleus*. Yet the characters which differentiate it are so distinct that it is one of the most easily recognized members of this large and difficult genus.

In cultivation *A. tongolensis* (Fig. 143) is a plant of about 45 cm. high with oblanceolate basal leaves (some plants of wild origin have spathulate leaves). The stem leaves are similar in shape but decrease rapidly in size so that the stems immediately beneath the flower heads are naked or with a few scale-like leaves. In cultivated plants the blue ray florets may be as much as 3 cm. long and 5 mm. broad and the orange-yellow disc 2 cm. in diameter (in wild material these parts are somewhat smaller). It is, however, in the pappus (the ring of hairs on top of the achene or "seed") that we find the surest spot-character for this species. It consists of a single series of brownish hairs, shorter than the achene and only about a third as long as the disc flowers.

Two commonly grown cultivars belong here but are, at present, wrongly ascribed to different species. They are *A. yunnanensis* 'Napsbury' and *A. subcoeruleus* 'Wendy'. These should be properly designated *A. tongolensis* 'Napsbury' and *A. tongolensis* 'Wendy'.

A. subcoeruleus is a synonym of *A. tongolensis* and was so placed by ONNO in his revision of this section of the genus in 1932 (Bibliotheca Botanica H. 106). *A. yunnanensis*, on the other hand, is a totally different species and, being a much more leafy plant, is less worthy of a place in the garden. Its pappus, again a critical feature, is as long as the disc flowers and double, i.e. it has an outer series of whitish scales.

A. GRIERSON

Royal Botanic Garden,
Edinburgh.

WISLEY TRIALS, 1957

BORDER CARNATIONS

Fifty-nine varieties of border carnations were grown at Wisley during 1957. Five plants of each variety were planted on October 31, 1956. The Joint Border Carnation and Picotee Committee of The Royal Horticultural Society and The British National Carnation Society inspected the trial on July 10, 1957, and on its recommendation The Royal Horticultural Society and The British National Carnation Society have made jointly the following awards to border carnations as varieties for the open border.

DOWNS UNIQUE. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd., Wivelsfield Nurseries, Haywards Heath, Sussex.) **H.C.** July 10, 1957. Plant vigorous with stout stems 28 inches long. Flowers 3 inches

diameter, freely produced, centre crowded, no scent; petals broad, slightly serrated, ground creamy-white, slightly striped Blood Red (H.C.C. 820); calyx strong. [42]

RENOIR. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** July 10, 1957. Plant vigorous with stout, rigid stems 24 inches long. Flowers 2½ inches diameter, very freely produced, centre full, scent slight; petals broad, entire, Straw Yellow (H.C.C. 604/2) overlaid with Shrimp Red (H.C.C. 616/1), when first open, edged and striped Imperial Purple (H.C.C. 33/1) with occasional touches of Rose Bengal (H.C.C. 25/1); calyx strong. [52]

SUSSEX CHEER. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** July 10, 1957. Plant vigorous with slender stems 28 inches long. Flowers 2½ inches diameter, freely produced, centre full, scent slight clove; petals broad, entire, ground pure white, edged and striped Fuchsia Purple (H.C.C. 28/1); calyx strong. [38]

SUSSEX JOY. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** July 10, 1957. Described R.H.S. JOURNAL, **81,** p. 502 (**C.** 1956). [54]

SWAN LAKE. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** July 10, 1957. Plant vigorous with stout stems 28 inches long. Flowers 2½–2¾ inches diameter, freely produced, centre full, scent strong clove; petals broad, entire, edges serrated, pure white; calyx strong. [8]

SARA ELIZABETH. (Raised and sent by Miss R. Goodfellow, Valley Nurseries, Aldridge, Staffs.) **C.** July 10, 1957. Plant vigorous with slender stems 30 inches long. Flowers 2¾ inches diameter, freely produced, centre fairly open, scent slight; petals broad, entire, ground white, finely striped and flaked Spinel Red (H.C.C. 0023); calyx very strong. [79]

SCARLET FRAGRANCE. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **C.** July 10, 1957. Plant vigorous with stout, rigid stems 26 inches long. Flowers 2¾ inches diameter, freely produced, centre full, scent strong; petals broad, edges serrated, Signal Red (H.C.C. 719/1); calyx strong. [14]

GARDEN PINKS

Ninety varieties of garden pinks were grown in the trial during 1957. Five plants of each variety were planted on November 26, 1956. The Joint Dianthus Committee of The Royal Horticultural Society, The British National Carnation Society and The Alpine Garden Society inspected the trial on June 27, 1957, and on its recommendation The Royal Horticultural Society, The British National Carnation Society and The Alpine Garden Society have made jointly the following awards to garden pinks as varieties for the open border.

The number in brackets after the description of the variety was that under which it was grown in the trial.

ANNE. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **A.M.** June 27, 1957. Described R.H.S. JOURNAL **81,** p. 503 (**H.C.** 1956). [47]

BLANCHE. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd., Wivelsfield Nurseries, Haywards Heath, Sussex.) **A.M.** June 27, 1957. Plant very vigorous, compact habit; flower stems 14 inches long, slender, rigid; flowers 2$\frac{1}{10}$ inches diameter, double, centre full, scent clove; petals broad, cut, deeply serrated, white with a very small blotch of palest greenish cream at extreme base; calyx strong. [29]

DAINTY MAID. (Raised, introduced and sent by S. T. Byatt, Esq., Ivythorpe, Hanworth Road, Hampton, Middlesex.) **A.M.** June 27, 1957. Described R.H.S. JOURNAL **81**, p. 195 (**H.C.** 1955). [26]

DEREK. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** June 27, 1957. Plant vigorous, bushy compact habit; flower stems 10 to 11 inches long, stout, rigid; flowers 2 to 2¼ inches diameter, double, centre full, scent slight clove; petals broad, slightly cut, finely serrated, Chrysanthemum Crimson (H.C.C. 824/2) flushed Rose Red (H.C.C. 724); calyx strong. (**C.** 1952). [55]

JUPITER. (Raised, introduced and sent by Messrs. Allwood Bros. Ltd.) **H.C.** June 27, 1957. Plant vigorous, bushy erect habit; flower stems 4 inches long, very slender, rigid; flowers 1 1/10 inches diameter, double, centre full, scent slight clove; petals broad, fringed, Solferino Purple (H.C.C. between 26/1 and 26/2); calyx strong. [44]

KATHLEEN HURST. (Raised by Mr. H. Hurst, introduced and sent by T. T. Burnett, Esq.) **H.C.** June 27, 1957. Plant vigorous, bushy very erect habit; flower stems 10 to 11 inches long, stout, rigid; flowers 2 inches diameter, double, centre full, scent strong clove; petals broad, very finely serrated, Carmine Rose (H.C.C. 621) flushed and striped Rose Red (H.C.C. 724/1); calyx strong. [86]

LITTLE BURNETT. (Raised, introduced and sent by T. T. Burnett, Esq., 18 Penn's Road, Petersfield, Hants.) **H.C.** June 27, 1957. Plant vigorous, bushy spreading habit; flower stems 11 inches long, very slender, rigid; flowers 1⅕ inches diameter, semi-double, centre open, scent strong; petals broad, deeply serrated, ground white laced and zoned Pansy Purple (H.C.C. 928/1); calyx strong. [27]

PLANTS TO WHICH AWARDS HAVE BEEN MADE IN 1957

Ceanothus impressus F.C.C. April 30, 1957. At one time considered a variety of *C. dentatus*, *C. impressus* has now been accorded specific rank. It is considered by many to be the finest of the evergreen ceanothuses.

The obovate or nearly orbicular leaves are alternate, ¼ to 1 inch long, dark green on the upper surface, grey downy beneath, and are furrowed above the veins and midrib. The margins of the leaves are decurved and glandular toothed.

The rich Gentian Blue (H.C.C. 42/2) flowers are borne in great profusion in globose or cylindrical shortly stalked panicles ½–1¼ inch long, and are well set off against the dark lustrous foliage (Fig. 142).

A native of California, *Ceanothus impressus* is a free-flowering and vigorous shrub for a wall, but it should not be planted in the open ground except in the most favoured of localities.

Exhibited by the Crown Estate Commissioners, The Great Park, Windsor, Berks.

Iris 'Elfin Motley' A.M. May 20, 1957, as a variety for general

garden use. Flower stems 9 inches long, very erect, two flowers per stem. Flowers well-proportioned; standards 2 inches long, $\frac{3}{8}$ inch wide margins waved, Buttercup Yellow (H.C.C. 5/2) veined along centre with reddish-purple; falls $2\frac{1}{4}$ inches long, $\frac{9}{10}$ inch wide, spathulate, waved, Buttercup Yellow (H.C.C. 5/2) around margins, overlaid and veined Blood Red (H.C.C. 820/2). Style and crest pale yellow. Shown by H. Senior Fothergill, Esq., 12 Abercorn Place, London, N.W.8 (Fig. 146).

Salix aegyptiaca A.M. January 22, 1957. Generally this willow is known by the name of *Salix medemii* or *S. cinerea* var. *medemii* and reasons for the adoption of the specific epithet under which it was exhibited will be found in the *Botanical Magazine*, Vol. clxvii, t. 91. The catkins appearing early in January and February are covered with dense, grey, silky down and bright yellow stamens. On the willow, the branches are stout and thick and plants may be easily propagated by hard wood cuttings rooted in the open ground in November. Exhibited by P. M. Synge, Esq., M.A., F.L.S., Clare Cottage, West Byfleet (Fig. 147).

Salix daphnoides A.M. February 19, 1957. This willow, exhibited by the Director, University Botanic Garden, Cambridge, is to be found naturalized in parts of this country. When exhibited, the cut branches of this plant were bloomed and reddish purple in colour. Borne on the stems were many handsome catkins, each about 3 cm. in length and 1 cm. wide and covered with silky silver hairs.

To obtain the full effect of the coloured stems in winter, hard pruning in the spring is to be recommended (Fig. 148).

BOOK NOTES

"Labour Saving Gardening." By Roy Hay. 115 pp. Illus. (MacGibbon & Kee.) 15*s*.

The true value of this book will be fully appreciated by all practically minded people as the author has himself obtained, by years of experiment and practical experience, the part-solution to the present-day challenge of labour and costs by making full use of the many gardening aids that science and mechanization has to offer.

Throughout the varying chapters he has dealt at length with the many gardening problems common to us all and how they can be best overcome in the light of his experience. Stress is laid on the planning and replanting of one's garden, a point which cannot be over-emphasized if full advantage is to be taken of the many technical aids now available. Likewise, the chapters dealing with the all-important use of electricity, irrigation, miscellaneous aids, etc., are full of sound, practical advice gained by the long and free use of such equipment. Further to this the author gives valuable guidance in selecting the right tool for the right job and, of course, at the right price. The chapter on garden mechanization by Sir William Godfrey is all one would expect from such an expert.

Although the size of the book does not permit going into great detail by covering, as it does, so wide a field it nevertheless will encourage and provide an answer to make the gardener's lot an easier and more interesting one in the future. It should appeal to all engaged in gardening whether they be professional or amateur as it contains a wealth of information and guidance to all concerned.

W. G. MACKENZIE

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BOOK NOTES

"Labour Saving Gardening." By Roy Hay. 115 pp. Illus. (MacGibbon & Kee.) 15s.

The true value of this book will be fully appreciated by all practically minded people as the author has himself obtained, by years of experiment and practical experience, the part-solution to the present-day challenge of labour and costs by making full use of the many gardening aids that science and mechanization has to offer.

Throughout the varying chapters he has dealt at length with the many gardening problems common to us all and how they can be best overcome in the light of his experience. Stress is laid on the planning and replanting of one's garden, a point which cannot be over-emphasized if full advantage is to be taken of the many technical aids now available. Likewise, the chapters dealing with the all-important use of electricity, irrigation, miscellaneous aids, etc., are full of sound, practical advice gained by the long and free use of such equipment. Further to this the author gives valuable guidance in selecting the right tool for the right job and, of course, at the right price. The chapter on garden mechanization by Sir William Godfrey is all one would expect from such an expert.

Although the size of the book does not permit going into great detail by covering, as it does, so wide a field it nevertheless will encourage and provide an answer to make the gardener's lot an easier and more interesting one in the future. It should appeal to all engaged in gardening whether they be professional or amateur as it contains a wealth of information and guidance to all concerned.

W. G. MACKENZIE

"Chrysanthemums the Year Round." By Sydney Searle and Barnie Machin. 273 pp. Illus. (Blandford Press Ltd.) 25*s*.

"Chrysanthemums the Year Round" may be dismissed by many as just another chrysanthemum book. This will be a mistake, because we have not had a book of this kind about chrysanthemums published in England before. All who read it will agree that it is something quite different and well worth while.

The majority of chrysanthemum-growers express the opinion that chrysanthemums are not wanted all the year round. This may be the very biased opinion of the traditional growers; on the other hand, there may be much truth in it. There is, however, considerable opposition to the idea, and I think because of this the title is an unfortunate choice, for in addition to the year-round chrysanthemum production we are told so much of general interest to the chrysanthemum-grower.

There are enormous numbers of chrysanthemum-growers, both amateur and professional, to whom the names of Sidney Searle and Barrie Machin are quite unknown. Read their book and you will realize that, whether known or unknown to you, they have a great knowledge of their subject. I am pleased to say that I know them both personally and have seen the results of the methods as practised by them. They can and do grow most excellent crops of chrysanthemums on a commercial scale at all times of the year. Previous chrysanthemum books have been written by practical men (some more practical than others) in simple, gardeners' language. This new book contains perhaps all of the basic facts of chrysanthemum-growing, but where it differs from the others is that it explains the scientific reasons for the methods which have been practised so long by the traditional chrysanthemum-grower.

Whether you are an amateur or professional grower, whether you are interested in year-round production or not, this book will be of enormous interest to you. It contains so much information of help to the traditional grower and tells how to use the available knowledge to produce better market crops economically at all seasons of the year. With this knowledge you can grow year-round crops if you so wish or you may be able to improve the crops you grow in their natural seasons.

"Chrysanthemums the Year Round" has been written mainly for the market grower and the student, but I am sure it will be of very great interest to the keen amateur grower of indoor chrysanthemums.

The results of the authors' methods are compared with those grown in the traditional way. One wonders if such young men could have seen first-class crops grown by the older well-tried methods. Three crops of flowers could be, and were, regularly produced between the end of July and Christmas in the same house. I like the new methods and can see that they may have a future, but I must say that I believe quality can never be better, if as good, as by the traditional method at its best.

In one or two cases the authors do not appear to understand the naming of the various "buds". This may be excusable, for it is a little obscure to most of us.

There are many excellent illustrations but some of those in colour are poor and add nothing to the usefulness of the book.

In the list of varieties at the end of the book a number stated to be American have the same names as British-raised varieties. I am sure that in some cases two varieties have received the same name; in others, English varieties have been reimported into this country from the United States. Perhaps this confusion over names could be cleared up in future editions.

I would like to thank the authors for a most interesting book, and we who read it are greatly indebted to Framptons Nurseries Limited for allowing the results of all the work that has been done on their nursery to be published for the general benefit of chrysanthemum-growers.

JOHN B. STEVENSON

ERRATUM

R.H.S. JOURNAL, **82**, March 1957: pp. 135–6. *Lilium oxypetalum insigne* **A.M.**—In the description of this plant the colour of the flowers was wrongly given as greenish-yellow. The flowers were dull purplish violet or mauve purple in colour, with a greenish midrib on each petal.

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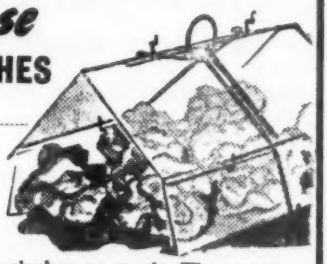

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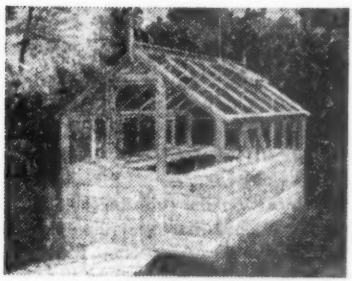

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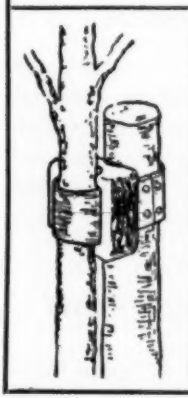

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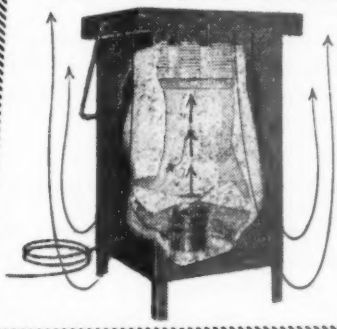

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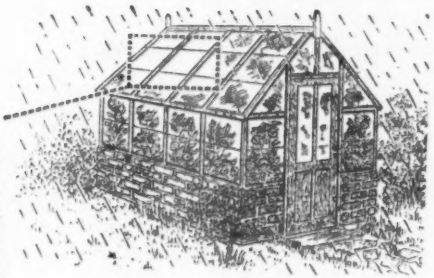

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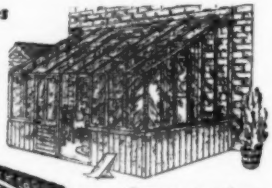

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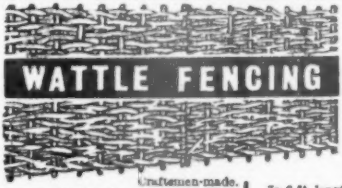

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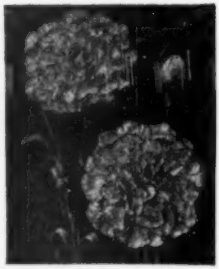

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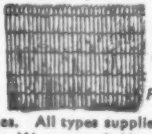

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